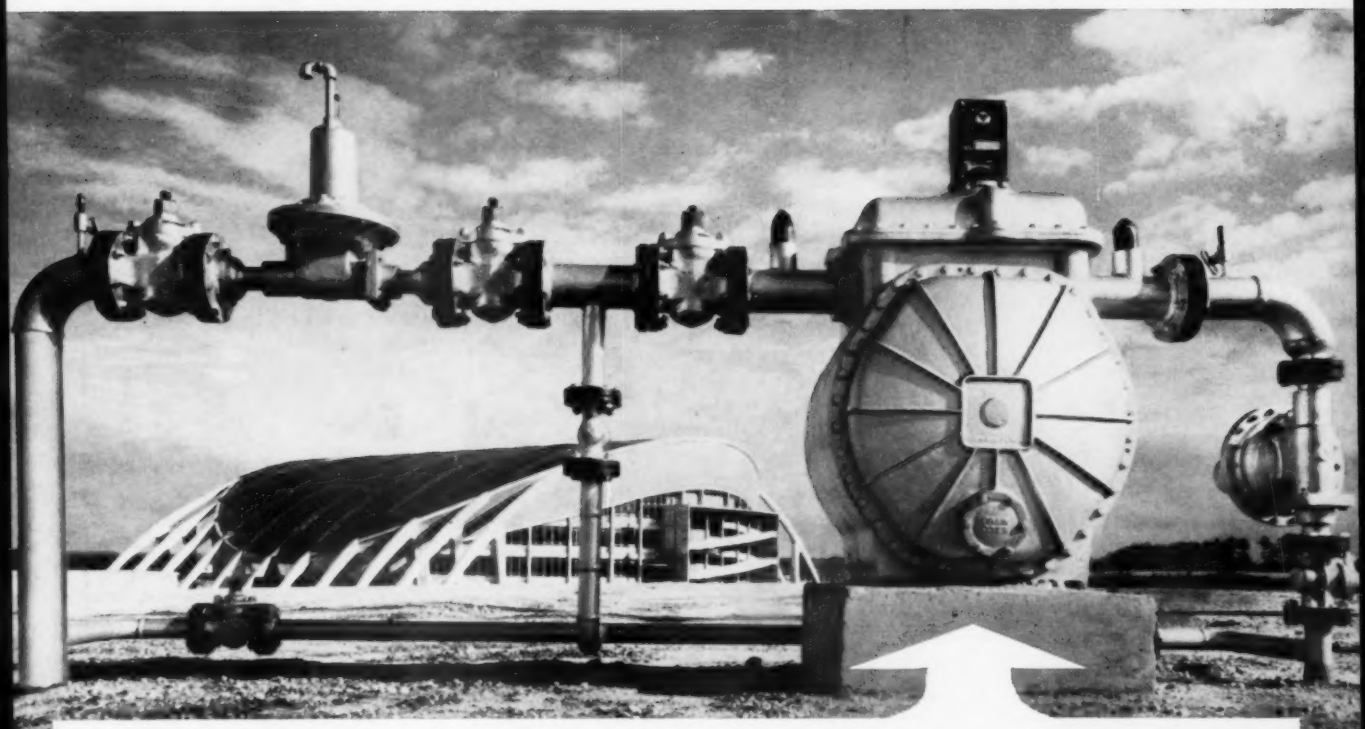
GAS

JUNE 1960

Using management science

A CHILTON PUBLICATION

THE NATION'S NATURAL GAS AUTHORITY



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36TH YEAR OF PUBLICATION

VOLUME THIRTY-SIX • NUMBER 6

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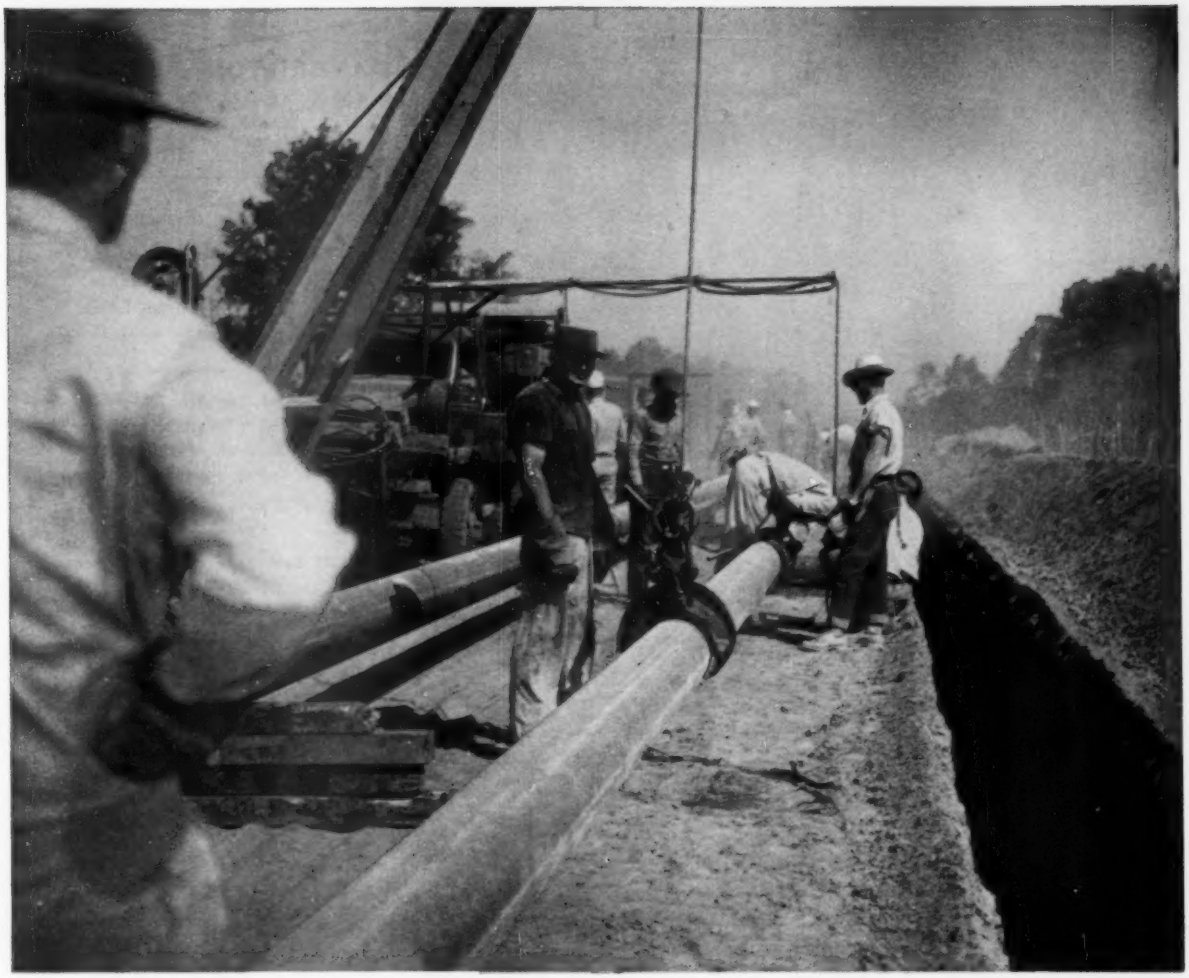

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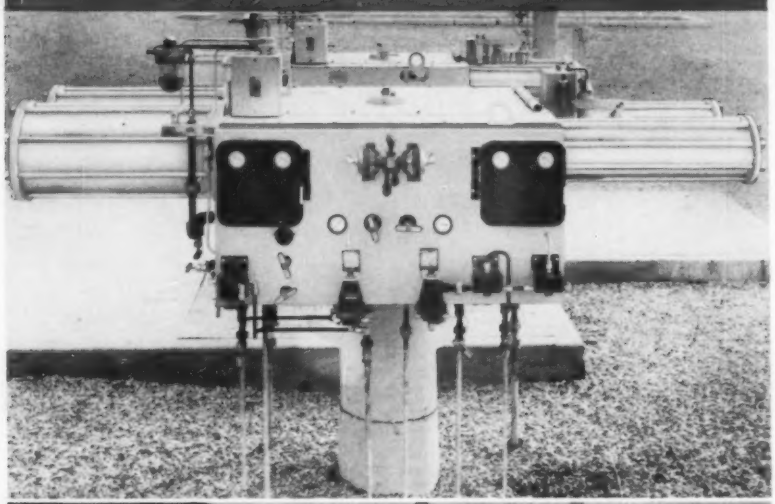

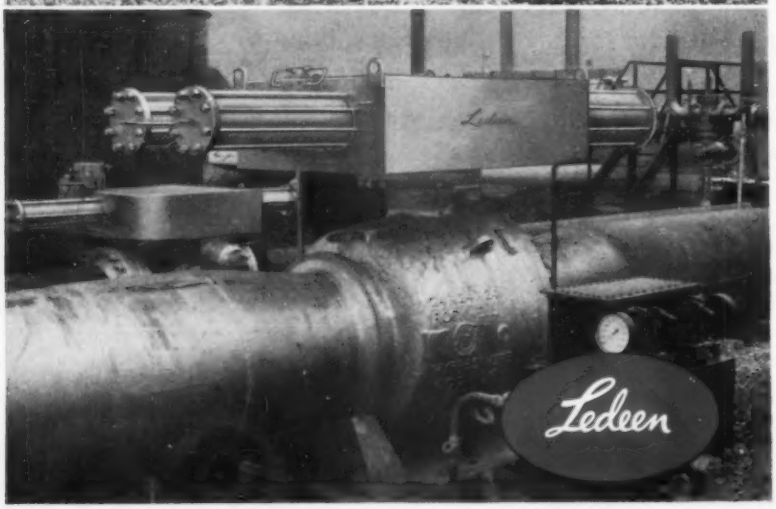

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J. Fred Ebdon, Editor
Robert J. Clay Managing Editor
William T. Harper, Eastern Editor
Barbara Hall, Assistant Editor

Guy Corfield, Technical Editor
Neil Regeimbal, Washington Editor
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GAS CALENDAR

June

1-3..Short Course in Gas Technology —Texas College of Arts & Industries, Kingsville, Texas.

1-3..5th Annual Appalachian Underground Corrosion Short Course, West Virginia University, Morgantown.

6-7..PCGA Research & Utilization Conference — Miramar Hotel, Santa Monica, Calif.

6-10..Institute of Gas Appliance Manufacturers — Netherland Hilton Hotel, Cincinnati.

8-9..PCGA Customer Service Conference — Miramar Hotel, Santa Monica, Calif.

22-25..Canadian Gas Association Annual Meeting—Manoir Richelieu Hotel, Murray Bay, Que., Can.

22-24..NEGA Gas Measurement & Control School—Worcester Polytechnic Institute, Worcester, Mass.

27-28..Michigan Gas Association Annual Meeting — Grand Hotel, Mackinac Island, Mich.

August

17-19..Mid-West Gas Association Gas School and Conference — Iowa State College, Ames.

September

12-14..AGA Accident Prevention Conference—Minneapolis.

21-23..Southeastern Gas Association Annual Meeting — Sir Walter Hotel, Raleigh, N. C.

21-23..PCGA Annual Convention — Westward Ho Hotel, Phoenix, Ariz.

22..NEGA Safety Conference—Statler Hotel, Boston

October

10-12..AGA Annual Convention—Atlantic City, N. J.

17-21..National Safety Council Annual Meeting—Chicago.

November

14-16..American Petroleum Institute Annual Meeting—Chicago.

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GAS

JUNE, 1960

Thermally Thinking

A FEW days prior to the recent AGA Operating Section's combined distribution and transmission convention in New Orleans, we took a field trip. By "we" I mean sales representatives, editors, the promotion manager, and the publisher of GAS Magazine.

We met in New Orleans and spent two days seeing some of the interesting gas production, transmission and distribution operations in the area. The field treks were particularly fascinating because the installations visited were in the offshore and swamps of southern Louisiana. Our sales representatives were particularly impressed with the country, its people and their food. They had not conceived large-scale gas industry operations in these locations and terrains.

If you could take your gas customers on such a trip, it is doubtful that you would ever again have too many complaints about the cost of gas. However, it is anything but practical to move 32 million-odd customers of the gas industry through the swamps of Louisiana. But a gas company can keep its customers constantly aware of the facts of the gas industry's life through several media.

One of the best ways to do this is to get employees out of offices and into the field as often as possible. Now I know that you can't transfer people all over the place at the drop of a hat, but you can take employees on periodic field trips. You might say that these trips can be turned into public relations efforts because a fellow who has spent a few days in the field sees some things that are, to put it mildly, a bit unusual and he is bound to tell his friends and contacts about them. Not only that, but a little meandering through the operational end of the gas business is educational to the office worker —be he chief engineer or clerk-typist. For many, it is a new experience. For most, it is at least a quick return to "basic training."

It is well to consider the "field" as not only the area or areas of your particular company, but that or those of the other segments of the gas industry. It is ideal if distribution company employees are given an insight into gas production and pipeline operations. Similarly, it is advantageous for pipeline companies to look in on distribution and production operations. Integrated companies have it made as they can take their employees through a couple or all three of the phases of the gas business within their own properties.

Most companies are very pleased to show people from other gas companies their installations and operations. The reason is simple: most companies are proud of their equipment and work. Some are so proud that they will even let magazine people invade their property in droves and give them every assistance, courtesy and cooperation.

A skillful administrative man can get his desk-bound forces into the field a few at a time with relatively little difficulty. They can't help but profit by it. You would be amazed at some of the conversations I have held with gas people. Some know little or nothing about the operations of their own company. In short, a magazine editor who gets around a little bit—gets into the field quite a bit—and with only a passing amount of ability at most, can be shocked by the lack of knowledge exhibited by many gas company people.

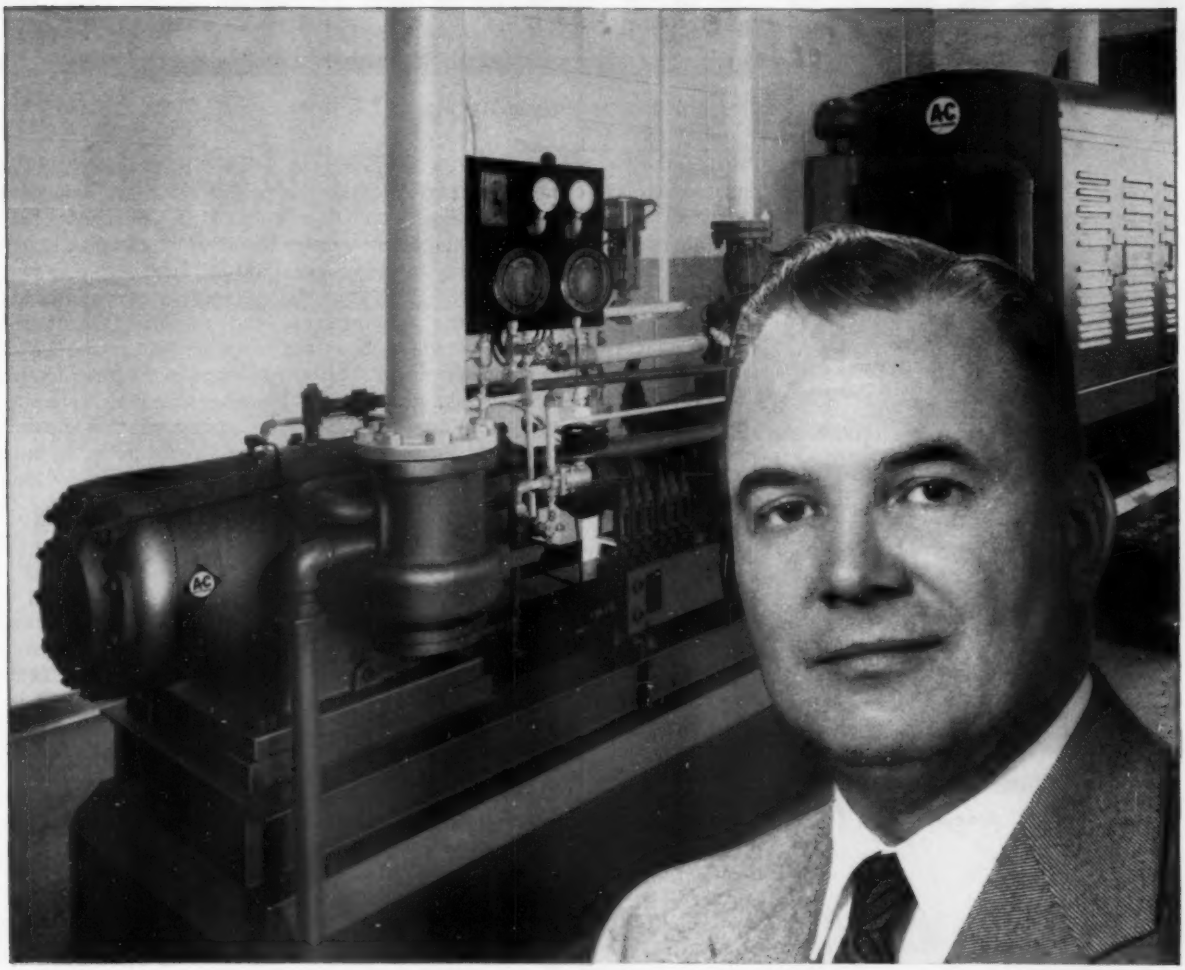
And let's face it, many things don't mean much until you have seen them. A compressor station, for example, or a meter shop; they are words to many gas company people. They may know the purpose of such installations; they may have seen pictures of such facilities in either company or business publications; but I can't help but feel that most of these people can't really tell their neighbors, contacts and friends about a compressor station or a meter shop until they have actually seen them.

Conventions can be a fine area for development of rather informal field trips. When your people attend conventions, they should be encouraged—and maybe stronger motivation might be used—to "take in" the gas industry operations in the vicinity of the town in which the convention is held.

A good gasman just can't sit still while gas operations that he hasn't seen are rolling along within half-way reach of him. Why not make it easier for Mr. Average Employee to see some of the gas industry's field operations and installations at every opportunity.

J. Fred Ebsen
EDITOR

ALLIS-CHALMERS



Mr. H. J. Ide, Vice-President Operations and Engineering, shown with the **"Ro-Flo"** compressors at Wisconsin Southern Gas Company's Lake Geneva peak-shaving plant.

Peak-shaving plants feel this improvement...

cut compressor costs and eliminate vibration with Ro-Flo units

Allis-Chalmers rotary compressors can lick your vibration problems as they did for the Wisconsin Southern Gas Co. In planning a new peak-shaving facility, the company wanted to avoid the threat that pounding of reciprocating units had posed to the very building structure of another plant. Solution turned up in this smooth running, cost saving, *Ro-Flo* compressor.

Ro-Flo units reduce maintenance, require less attention between operating periods, and call for little floor space. Easy-to-reach controls and maximum enclosure of moving parts increase operator safety and convenience. Models available in sizes for all needs.

For full information on *Ro-Flo* compressors, motors, control and other components for peak shaving, contact your nearby A-C office or write **Allis-Chalmers,** Industrial Equipment Division, Milwaukee 1, Wisconsin.

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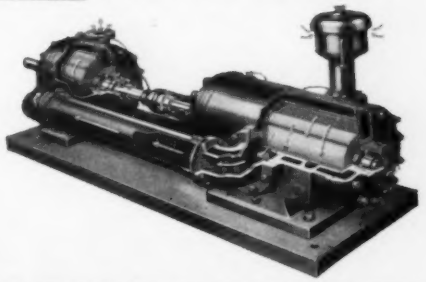


Smooth, quiet-spinning rotors produce powerful compression without use of pistons. **Ro-Flo** design lets compressor always start out unloaded to minimize torque requirements. Can be driven by gas engines, steam turbines or electric motors. A-1322

GAS HIGHLIGHTS

What's next for FPC?

President Eisenhower pulled a surprise out of his golf cap when he appointed to the commission two veteran government attorneys who have no regulatory commission background. Both political independents, they are: Thomas A. Donegan, who takes over for William R. Connote's seat when his 5-year term runs out June 22; and Paul A. Sweeney, who succeeds the late John B. Hussey. The immediate questions were whether the Senate would confirm the appointments and to what extent the appointments would delay commission action on a growing backlog of cases. Some senators may resent Ike's failure to appoint another known advocate of consumer interests in Connole's place. Democratic senators, on the other hand, may want to adjourn without approving the appointments. This means that only temporary appointments could be made until a new senate and a new president are seated. Estimates as to how long the appointments will hold up FPC action range from several weeks to one year.

Still more gas for California

The apparently never-to-be-satisfied California market gets another huge gas supply—this time from Canada. An FPC examiner gave his blessing to the vast project which will move 584 MMcfd from Alberta's gas fields into California and the Pacific Northwest. (See page 126 for details.)

"Shinny up that tree, boys!"

"The rich fruits of this decade will fall to those who shake the tree the hardest. And if our competition shapes up as we expect it will in the next few years, we may even have to shinny up the tree to get the best pickings." With those words, AGA President Wister H. Ligon opened the group's 1960 Distribution and Transmission Conference in New Orleans May 9. President Ligon reeled off a batch of very pleasant-sounding statistics (see page 65) but the gist of his talk might be summed up in eight words: "The Sixties look great, but don't get complacent."

Transwestern completed—1800 miles in 128 days!

Just about the time most of you had finished the last paragraph on the 20th (and last) page of last month's Transwestern Pipeline story, the last weld was made on the 1800-mile line. This gigantic project was completed in 152 calendar days, or an average of 128 working days for the 11 spreads. For a progress report on other aspects of the project, see page 122.

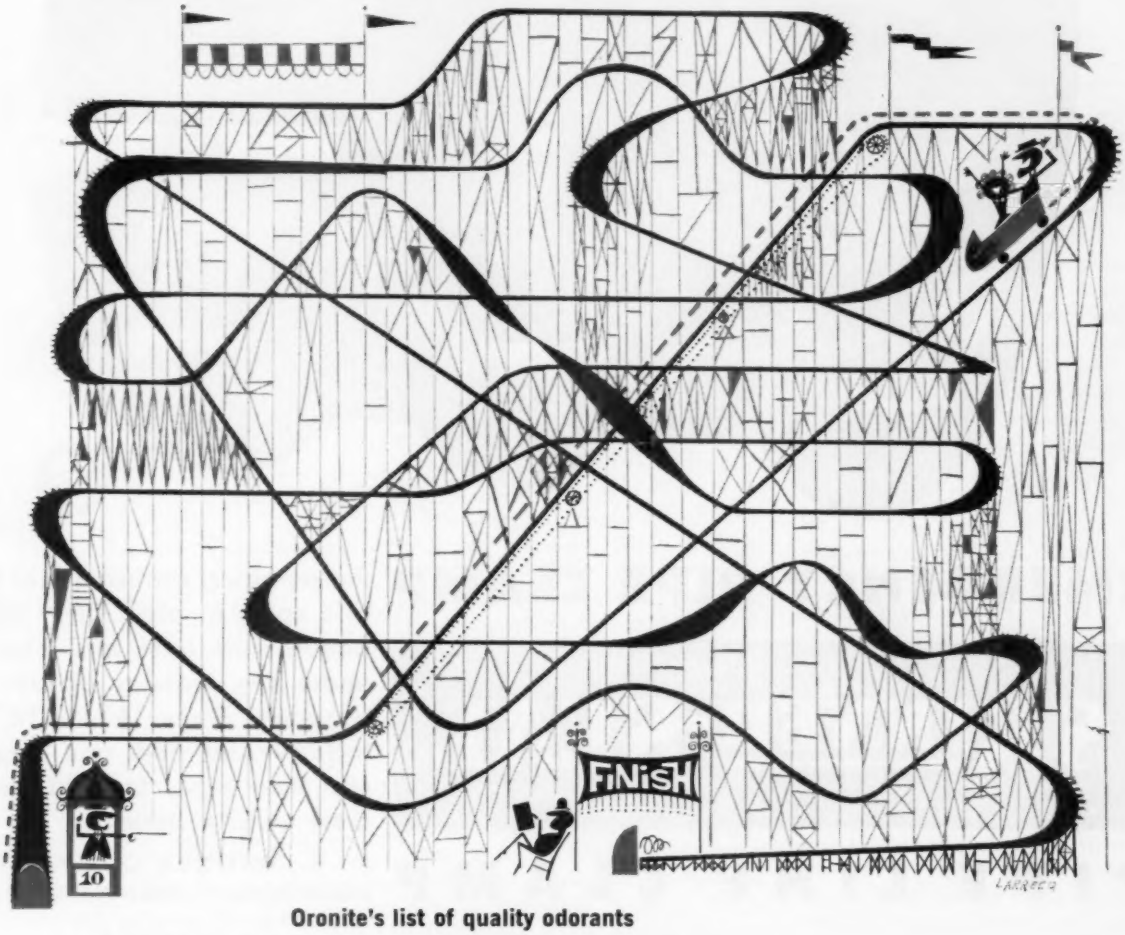
Supreme court and kilowatters

Two cases now in the news (see page 122) involved supreme court decisions on selling natural gas for electric power plants: The U. S. Supreme Court has agreed to review the right of industrial users and distributors to buy gas directly from a producer and have it transported by pipeline, thus escaping federal controls. Involved is a contract between Consolidated Edison Co. (New York) and Transcontinental Pipe Line Corp. Arguments will be heard after the court opens its next term in October.

The Colorado Supreme Court ruled that the state cannot regulate the price of gas sold to industrial users by Colorado Interstate Gas Co. The court thus reversed a PUC directive that the sales made the company a utility.

Is your gas odorant getting to the end of the line?

If you have the critical problem of detectible "end-of-line" odorization, let us discuss Oronite Calodorant "C" with you. Many users tell us it is the most stable odorant on the market. A cyclic sulfide type product, Calodorant "C" does not fade, oxidize, cause corrosion or deposits.



Oronite's list of quality odorants

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Alert 101	new tertiary-butyl mercaptan based odorant
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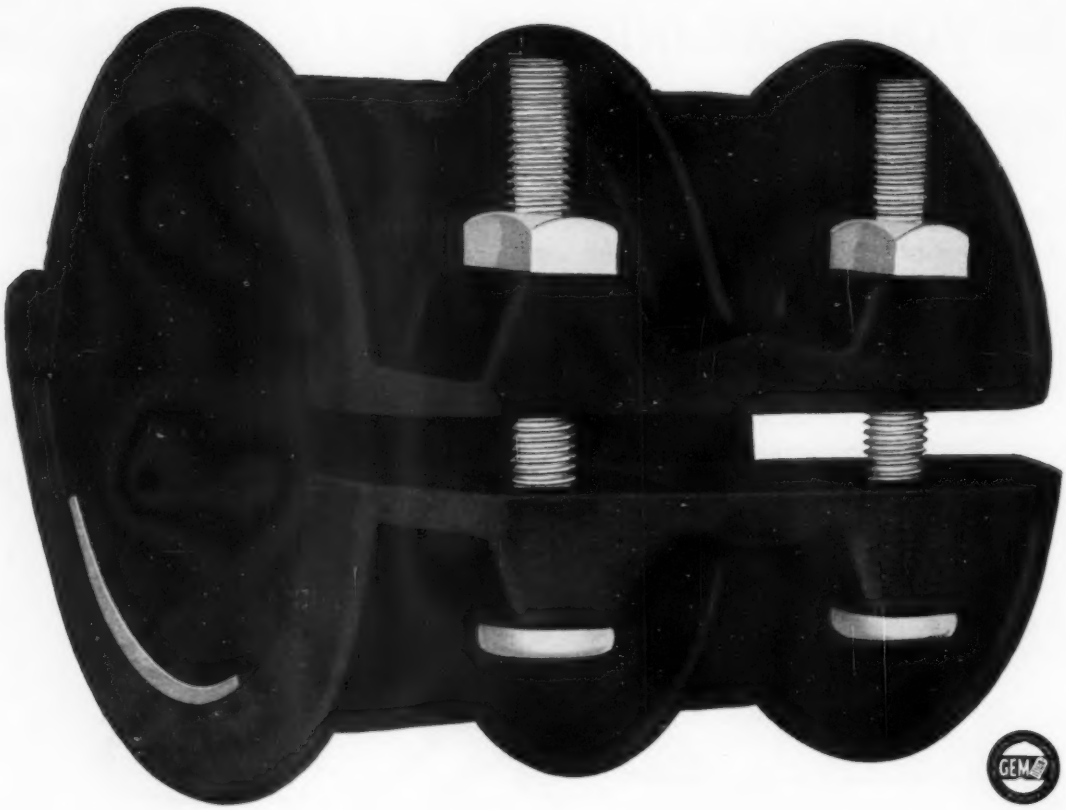

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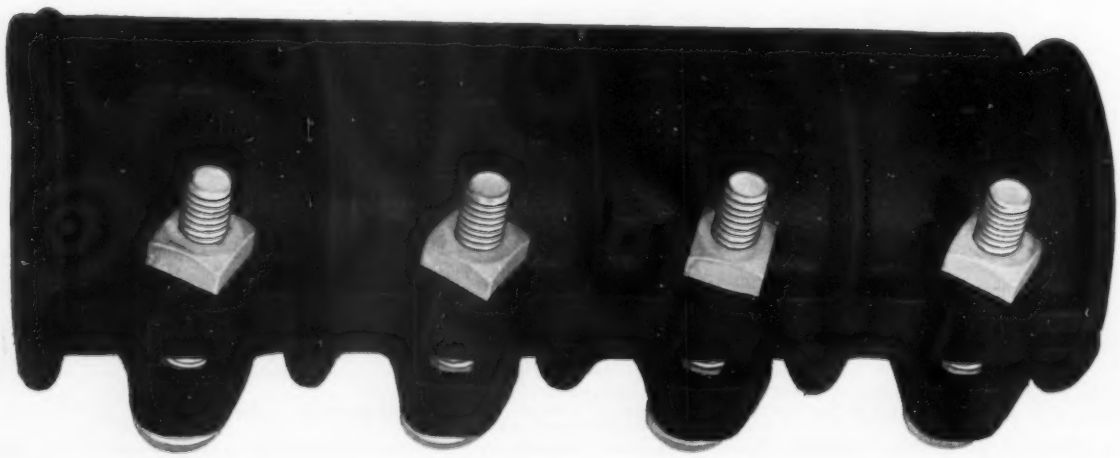


Regulatory and Legislative Trends

A COMMENTARY ON NATIONAL AND STATE DEVELOPMENTS BY AN EXPERT IN UTILITY LAW

Price increase pains

THE many pains experienced by a utility in obtaining a rate increase is illustrated by a recent Louisiana Supreme Court ruling.

The court decided that the PSC allowed such a low return that the prescribed rates for service were unjust. It ordered a $2 million price increase for the utility. The commission had failed to allow a return comparable to that earned by other utilities with similar risks. The court held that the result reached by a rate-making agency was controlling rather than the method employed. It is not the theory but the impact of the commission's rate decision that counts.

The court's opinion is enlightening. A brief of its main points will assist management.

• Abnormal advertising expenses

The company complained because the commission refused to take into account an expenditure of $225,000 during the test year. This money went for advertising purposes, ostensibly to inform the public about the company's application for a rate increase.

The PSC reviewed rulings of courts and utilities of other states which condemn the practice of utilities using ratepayers' money to conduct an advertising campaign to increase rates to be charged to the ratepayer. Then this item was disallowed—not on the grounds of impropriety, but because, as the commission, stated:

"It is sufficient for our purpose that the record clearly shows these expenditures to be abnormal and nonrecurring in character and that their inclusion in the operating expense accounts would distort the test-year earnings."

The court agreed with the commission on the disallowance. But it reminded the commission that ordinary advertising expenses should be recognized in rate-making.

• Capital structure

The company opposed the commission's use of a formula based on a 45 per cent debt ratio and 55 per cent common stock equity in its determination of a fair rate of return when its debt ratio averaged only 24.7 per cent, during the test period. According to the record, this debt ratio actually exceeded 45 per cent in 1947 but it has steadily been reduced since that time.

The company argued that the commission invaded the reasonable range of the discretion of the company's board of directors when it, in effect, attempted to determine the amout of debt which the utility must incur. The court rejected the company's contention. It pointed out that there is no prescribed formula set by the Constitution or the legislature for the fixing of "just and reasonable" rates for public utilities. The commission, therefore, is given wide discretion in adopting any reasonable formula as long as it results in rates which will enable a utility to operate successfully, to maintain its financial integrity, to attract capital, and to compensate its investors for the risks assumed.

• Cost of debt capital

The commission may be theoretically right in that the utility, according to the formula, should have maintained a debt ratio of 45 per cent, and should have sold its bonds while interest rates were lower. However, the court agreed with the company that this is unrealistic. The utility must raise additional money at current and future cost, to meet the new formula and to carry out the vast expansion so needed in Louisiana.

The Court said that the company should be given a reasonable time to adjust its debt ratio to the new formula, should it so desire. Two of the expert witnesses testified that it will take about five years to accomplish this. Not only must $37 million be raised immediately. Other millions both in debt capital and equity capital must be raised for expansion. The court found that "The commission has, in effect, made its new formula retroactive. We do not believe this is just and reasonable."

• Reproduction cost rate base

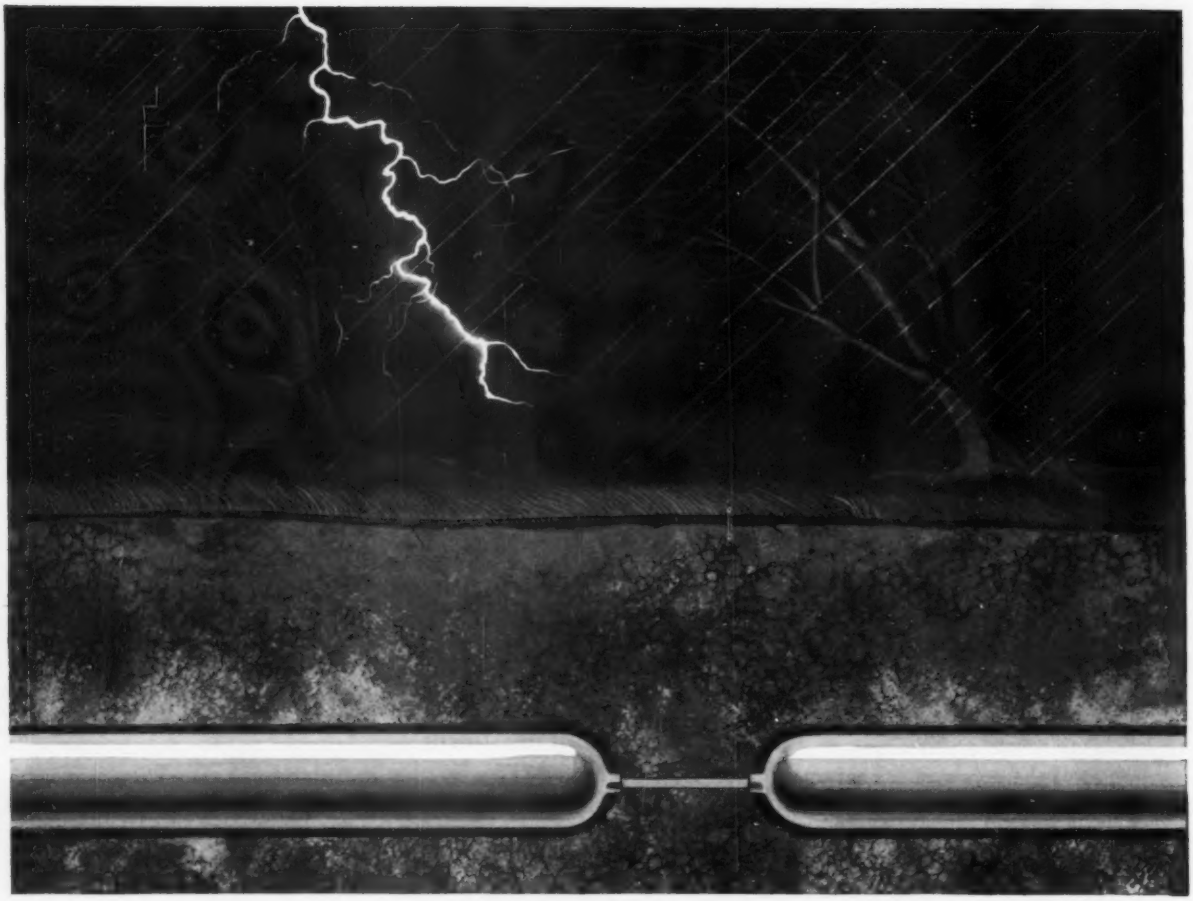
The utility contended that the commission erred in excluding the testimony and exhibits relating to present-day reproduction cost less depreciation. The Supreme Court asserted: "Louisiana has never adopted the reproduction cost new less depreciation theory of rate making. Estimates of reproduction cost new less depreciation are too conjectural to have probative value." * * * "Since the commission has adopted a new formula based on the prudent investment theory, we see no error in excluding evidence relative to another formula which has never been adopted in Louisiana."

• Earnings must be fair

Louisiana's Supreme Court criticized the commission for its unfair treatment of the utility:

"It is obvious that there is a great disparity between the return received by Southern Bell on its property rate base as well as on its equity capital and the return received on property rate base and equity capital by other utilities in

Continued on page 90



How to protect gas from lightning

Store gas underground in USS National Seamless Steel Bottles. Down there, gas is safe from wild storms and hurricane winds. Since National Seamless Steel Bottles are buried underground, atmospheric conditions have little or no effect. And maintenance costs are virtually eliminated—a big saving to the user.

Any bottle can be cut off the line for inspection or minor repairs —without bothering the gas pressure in the remaining groups of bottles. API Grade N-80 steel is used in these bottles. It has a minimum yield strength of 80,000 pounds per square inch. Generally, each bottle holds 26,000 cubic feet of natural gas at 2400 psi.

Write for our booklet on USS National Seamless Steel Bottles. National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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PROOF THAT CHEVY'S BIG NEW CABS ARE BUILT FOR A BETTER DAY'S WORK!

"THESE TRAILS WOULD SHAKE THE CAB OFF AN ORDINARY TRUCK...BUT NOT OUR CHEVY"

Few trucks are subjected to the body-wracking beatings that are part of a day's work for this Chevrolet Series 60 pulpwood hauler, owned by J. E. Fox, North Carolina logging contractor. As Bobby Fox, a partner in the business points out, "Loaded full-up with pulpwood, we drive right over stumps and potholes you'd think would tear the truck to pieces. These trails would shake the cab off an ordinary truck, but not our Chevy. Chevies are built to hold together longer."

■ No matter where you haul, you'll profit by the new toughness that's built into Chevrolet truck cabs for '60. You'll benefit from a cab that stands up to slam-bang runs over rough terrain, a cab that stays in A-1 shape years longer. Here are some of the ways in which Chevy assures this tight, maintenance-minimizing performance:

1. Tough new longitudinal sills reinforce the underbody; provide a solid foundation for cab sheet metal.

2. Extra-sturdy door openings—box-section pillars and sills assure lasting alignment. Doors stay weathertight with a minimum of maintenance.

3. New double-walled roof makes cab stronger and safer. Box-section pillars provide solid roof support.

There's a world of comfort for you, too. A wide seat, for instance, that softens the ride yet gives you extra support where it's needed. And there's more head room, hip room, shoulder room and leg room for rangy drivers.

First chance you get, visit your dealer and drive a new Chevy. Experience new Torsion-Spring Ride. Check up on Chevy's famous gas-saving 6's and V8's. Then you'll know, for sure, why you can expect thousands of extra miles out of a Chevy; why you can be sure of more work per day at least expense. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

1960 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

CHOICE OF EVERY MAJOR U.S. GAS DISTRIBUTION COMPANY

DEPENDABLE Assured by unique simplicity of design and construction. Only one moving part, a tough, resilient rubber tube that can never stick or wedge, serves as both diaphragm and valve.

QUIET There is no "slamming". The rubber tube silently rolls on and off the slotted metal body core. Actually, the quietest valve you can use.

VERSATILE Use for pressure reducing, remote control operations, back pressure control, automatic shut-off and manual open-shut flow control. May be self operated or used with electrical, pneumatic or hydraulic actuated pilots. Can handle gas, water, most petroleum products. Available in sizes 1" to 12", working pressures to 1500 psi.

write for technical data bulletins

GROVE VALVES

GROVE VALVE AND REGULATOR COMPANY
A Subsidiary of Walworth
6529 Hollis Street, Oakland 8, California
Offices in principal cities throughout the U.S.
In Western Canada: Grove Valve Ltd., Edmonton 6323

TECHNICAL TRENDS

By GUY CORFIELD

Detecting hydrocarbons by flame ionization

American Cyanimid has developed a new means of detecting very low concentrations of hydrocarbons in air, using an apparatus called the flame ionization continuous analyzer (FICA). This apparatus consists essentially of a stainless steel hypodermic needle which is used as a miniature gas burner to support a small flame of hydrogen gas; a platinum screen located 7.5 mm above the burner tip; and a means of impressing a 300-v potential between needle and screen. The needle is the anode and the screen the cathode. The air-hydrocarbon sample to be tested is introduced into the hydrogen flame where hydrocarbons are "cracked" to produce carbon radicals and release electrons. This release of electrons changes the electric field strength at the screen, and measured variation of field strength indicates the amount and type of hydrocarbon.

Sensitivity of this apparatus is of the order of 1 to 10 parts per billion, depending on whether there is a single hydrocarbon or a mixture. If the hydrocarbons in a mixture are pre-separated by passage through a silica gel chromatographic column, FICA can detect the individual components. Non-hydrocarbon gases do not give a signal because they do not ionize at flame temperatures. While not yet produced commercially, the price of the apparatus is estimated at about $500, the basic weight will be about 10 lb, and it can be made portable and self-contained by the use of batteries.

Another look at the Athabasca tar sands

In the search for future supplies of petroleum, the oil industry continues to be fascinated by the Athabasca tar sands. This fabulous deposit is in a 30,000-square mile area in Alberta, Canada, 250 miles north of Edmonton and 600 miles north of the U. S.-Canadian border. It is estimated to contain 300 billion bbl of hydrocarbons, equal to the world's known crude oil reserves. Some 40 billion bbl lie at or close to the ground surface and are therefore relatively available to surface strip mining.

The structure is actually a sand impregnated with a tarry bitumen that, when extracted, has an API gravity of 7.5 degrees, a 50 per cent distillation point of about 1000 degrees F and is solid at normal temperatures. It contains about 5 per cent sulfur and 200 ppm of vanadium. The average bitumen content of this sand is 10 per cent by weight.

The latest major development effort is being made by a group of companies including Imperial Oil, Ltd.; Cities Service Athabasca, Inc., Richfield Oil Corp.; and Royalite Oil Co. Ltd. This group is operating a $3.5 million, large-scale pilot extraction plant at Mildred Lake near the Athabasca river about 30 miles north of Fort McMurray.

The bitumen-impregnated sand is dug from a hillside by a large bucket-carrying wheel and dumped on a conveyor belt, screened, and fed to an extraction unit where it is treated with a light hydrocarbon solvent. Hot water is then added, releasing the clean sand which separates and is discarded. The mixture of solvent, bitumen and water is then pumped to a separation plant where the hydrocarbons are decanted off, leaving the water for re-cycling to the extractor. The hydrocarbon mixture is then charged to a solvent recovery unit to drive off the solvent which is also recycled. The final virgin bitumen, other than a portion used for plant fuel, is fed to a visbreaker (thermal cracker) where it can be roughly fractionated for further treatment.

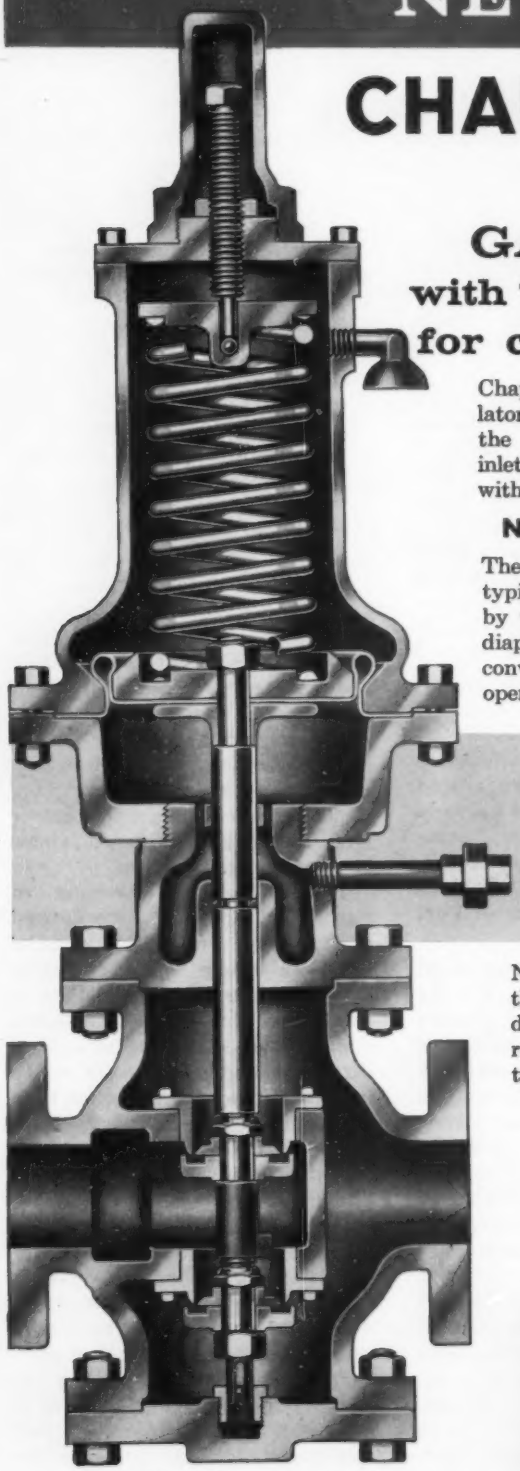
Implosion vs. explosion

An implosion is, in a sense, the reverse or opposite of an explosion. An explosion involves release of matter at high pressure into an area of much lower pressure. An implosion, conversely, is effected by sudden collapse of a low pressure area surrounded by much higher pressure media. The rupture of an electric light bulb, with the resulting inrush and impact of air to create a shock wave and audible pop, is a familiar example of an implosion.

In oil, gas and water well operation, it is often necessary to rupture or fracture underground formations at a certain level, to assist withdrawal or injection of fluids. This is sometimes accomplished by applying pressure from the surface to liquid in the well, or producing explosions at the level or in the area where fracturing is desired. However, it has been difficult to confine effects to the exact spot or level desired, and implosion is now being used with success.

This is done by lowering an "implosion capsule" to the desired level in the well. The capsule, usually a strong walled evacuated glass cylinder, is prepared in a length and diameter to fit the job, and designed to collapse at a given externally applied pressure which is developed by the combined head of liquid above it and pressure applied at the ground surface. When collapse occurs, fluid flows into the resulting void at velocities of several hundred miles per hour. As the void fills and the motion of the descending column of liquid is abruptly stopped, through a period of about 0.01 sec, stored up energy of the column is released as pressure which is applied to the immediate face of the well bore. It has been calculated and verified experimentally that pressure developed by such an implosion is 2 to 3 times as great as the pressure required to collapse the capsule.

NEW IN PRINCIPLE!
NEW IN DESIGN!



2" - 3" - 4" - 6"
Write for Bulletin 57-S

CHAPLIN-FULTON

Model 57-S

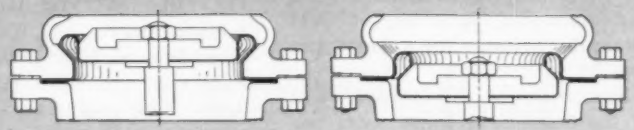
GAS REGULATOR
with "ROLL-OUT" Diaphragm for constant pressure control

Chaplin-Fulton Model 57-S is a simple spring loaded regulator which performs like a pilot loaded regulator, without the added complications. For pounds-to-pounds service—inlet pressures to 400 psi—controlled pressures to 75 psi, with deviation through full valve travel less than 1 psi.

NO "FALL-OFF" AS FLOW INCREASES

The drooping characteristics or outlet pressure "fall-off", typical of conventional spring regulators, is eliminated—not by using an uncontrollable velocity effect—but by a new diaphragm design which actually reverses the action of a conventional diaphragm. It changes its area as the valve opens to compensate for the loss in spring loading force.

"ROLL-OUT" DIAPHRAGM PRINCIPLE



VALVE CLOSED VALVE OPEN

Note how, with the valve upwards in the closed position, the diaphragm achieves its maximum effective area—and decreases as the valve opens. The area changes at the same rate as the spring loses compression, to give a constant controlled pressure—determined entirely by valve movement.

ACCURATE CP MFG CO DEPENDABLE

Chaplin-Fulton
MANUFACTURING COMPANY
Pittsburgh 25, Pennsylvania

WASHINGTON

By NEIL REGEIMBAL
GAS Washington Bureau

Furor to have long-lasting impact

IMPACT of the current uproar over policies, practices, and FPC members is far greater on the gas industry than the immediate headlines suggest.

The obvious damage the industry is suffering includes a deep setback for natural gas legislation, and again a general lessening of trust in the industry by the consumer.

But there will be other serious and long-lasting results of the election-year uproar over closed-door contacts between representatives for gas producers and pipelines and the FPC and free airplane rides and probably other favors accepted by FPC members from the gas industry.

For some time now, daily newspapers across the country will look closely into all gas rate increases. Distributors can expect increases in pipeline rates, and details of contracts to supply gas to industry to continue to result in implications that there may be "gouging" or "rate tilting" going on which boosts the cost of gas to the homeowner.

At the FPC, with at least two new members in prospect to replace the late Commissioner John B. Hussey and the not-to-be-reappointed William R. Connole, the gas industry can expect some extra hard going in the months and even years ahead.

Top staff aides at the commission confirm what is obvious when the uproar subsides. The FPC is going to move mighty slowly in granting rate increase. This will inevitably mean more rate and certificate suspensions, more detailed and thus longer investigations, and probably slimmer returns. As a result, the incentive for new gas production will be cut back at least a little.

The legality and morality of the actions which Rep. Oren Harris and his House Commerce investigating subcommittee have been probing can be argued almost to infinity. At most, they are on the borderline.

But the lack of political judgment displayed is clear. And the damage it causes spreads much farther than the few people directly involved.

It was clear to many Washington observers as long as two years ago, when the House subcommittee first began digging into the so-called independent agencies, that the FPC would eventually come under fire.

The accusation underlying all the surface charges against these agencies is that they play too closely to the industries they are supposed to regulate and control for the benefit of consumers and the public in general.

This is rarely a valid charge. But to the vast uninformed public, from which the congressional headhunters get their drive, the actions of the commissions and boards and their methods of operation make it appear to be so.

As a body, these agencies for years have hidden behind a tissue paper cloak of presumed quasi-judicial powers, hidden from the spotlight of public interest. The members, appointed and seemingly protected by political chiefs, have tended to conduct their affairs far more privately than any court. While they may admit their eventual duty to the public, too often they have presumed that their methods are no one's business.

Many of these officials, from all agencies, have used of all things their right to "refuse to discuss a pending case" as the tin armor to protect them against questions from observers. But their willingness, perhaps correctly, to discuss them with interested parties looks worse.

The FPC, as this correspondent has said before, has done an outstanding job on official announcements. Copies of final decisions, in their usual tortured legal style, are made available in mounds, with press releases explaining them.

But up to about 18 months ago, the philosophies, beliefs, and plans of the commission and commissioners rarely came out in public speeches, in public statements, interviews, or what not.

By the time the commission began trying to do a better job of explaining its methods and purposes, and adding a few human elements in doing so, the seeds of the present scandal were already sown.

The present probe is purely political. It may die away without drawing any blood, only some slow-healing bruises. Or it could cause heads to roll. The Southern Democratic congressional bloc decided when the first hint of questionable practices leaked out that it would try to "get" FPC Chairman Jerome Kuykendall, according to sources inside this caucus. So did many Northern "liberals."

The chairman, who has borne the brunt of the probe, is a Republican and an Eisenhower appointee. While Thomas Corcoran, representative of the Midwestern Gas Transmission Co., who is also involved, is a Democrat, he was a leading New Deal official. Southern Democrats have little reason to

Continued on page 91

*Your **FISHER/MAN** says: Have your cake and eat it too!*

THE IDEAL REGULATOR FOR OVER-RIDE OR MONITOR SERVICE

Big flow capacity with very low pressure drop

the FISHER 298T-3057

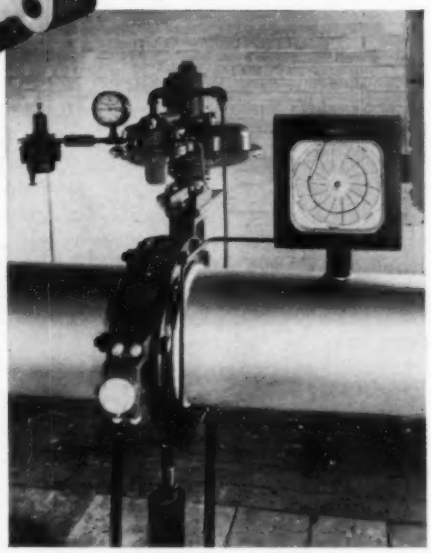
ultra-sensitive regulator

- Low initial cost
- High capacity with low pressure drop
- Sensitive regulation
- Reduced maintenance
- Ideal for accurate metering
- Wide rangeability
- Highly stable—non-pulsating
- Widely used as over-ride or monitor type regulator, or as a district regulator

The excellent throttling characteristics of the butterfly valve, in combination with the ultra-sensitive Type 298T topwork, make this unit ideally suited to installations requiring high flows, and where only a very low pressure drop can be permitted.

The combination of the 298T and the 3057 maintains constant downstream pressures within very narrow limits, and is particularly well suited as a monitoring or over-ride regulator. In cases where space is at a premium, the 298T-3057 can frequently help solve the problem because it takes up only a few inches of line space.

Type 298T topwork is available in two sizes: Size 50 with maximum control pressure of 65 psi, and Size 60 with maximum control pressure of 35 psi.



12" 298T-3057 installation in New England reduces 8" to 40" WC to 7" WC outlet pressure. Capacity range is 20,000 to 80,000. Previously two 20" regulators were required. The Fisher 298T pilot operated actuator used in combination with a Fisher-Continental Butterfly Valve therefore represented substantial savings in initial and installation costs.

For further information and specifications write for Bulletin No. P-84.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

By MARSHALL E. PARKER

Current requirements and current demand

THERE is a growing tendency to confuse the terms "current requirements" and "current demand" as applied to pipelines under cathodic protection. The first means simply the amount of current required to place the line under cathodic protection. The second means the amount of current which will actually flow under a certain set of conditions—without reference to whether or not this amount of current is too little or too much for adequate protection.

Actually, neither term is quite as simple as the definition makes it seem.

The current requirements of a given line, for example, vary according to the system of drainage; it takes more current to protect a line with a single unit at one end than it does with one in the middle; it can be protected with still less current with a number of units. Finally, if we can imagine uniformly distributed drainage all along the line, the least possible amount of current is required. This latter quantity might properly be called the true current requirement of the line, but we are actually seldom interested in such a quantity. What we usually want to know is "how much current will be required to protect this line with this particular arrangement?"

Once we have installed and connected a rectifier and ground bed, or some other type of drainage system, it will be found that the actual current flow varies, without any change or adjustment in the apparatus. This fluctuation is properly to be considered as a change in current demand. It is usually due to changes in the resistance of the earth part of the path, and most often to changes in the moisture content in the immediate neighborhood of the anodes. It is subject to variations in the moisture content around the pipe, too; it is also subject to progressive or sudden changes in the coating, and to a few other factors. When a system has been installed and adjusted to give adequate protection with a current drain of, say, 8 amp, and a few months later, without any change having been made in the adjustment of the unit, the current is found to be 10 amp, then it is correct to say that the current demand of the system has increased from 8 to 10 amp. Presumably, if the adjustment originally made can be assumed to be correct, the initial current requirement was 8 amp —at least with the particular set of drainage points involved. But, can we say that the current requirement has increased from 8 to 10 amp? Can we say that it has increased at all? Can we say that it has changed? Or can we say that it has not changed?

The answer to these questions is *"no."* We have no information as to the present current requirements of this line. The only way to determine this is through a survey, which finds whether or not the line is adequately protected, and, if not just exactly protected, how much the current will have to be increased or decreased to achieve just barely adequate protection.

Yet we see article after article in which tables are given, and graphs are shown, all described as showing the variation of current requirements with rainfall, or with temperature, or perhaps just seasonally without an attempt to interpret the true cause. But if we read these articles, we see that often it is merely current demand which is being followed, not actual current requirements. A system, presumably functioning properly and affording adequate protection, is simply watched over a period of time, and the fluctuation of the current flow is observed and recorded. Very often an important part of the study is during winter months, when the measurement of pipe-to-soil potential, and hence of protection, is all but impossible.

This is not to deny that the true current requirement of a buried pipeline varies with rainfall, moisture content, and the like. It certainly does. But it is not quite so easily measured. More is required than the mere observation of an ammeter, or a number of ammeters. It is necessary to determine the degree of protection actually being achieved, and the amount of current required for just adequate protection.

It is not necessary that a complete survey be made for every point on a curve showing variation of current requirement. For a line with only one drainage point, it should be sufficiently accurate to measure pipe-to-soil potential at one point — preferably the low point, or one very close to it. At the time this is determined, a small change should be made in the drainage current, and the change in pipe-to-soil potential corresponding to this change should be observed. It may then be assumed that further changes in current would meet with a linear response in potential; hence the extrapolation to the actual current required can be made.

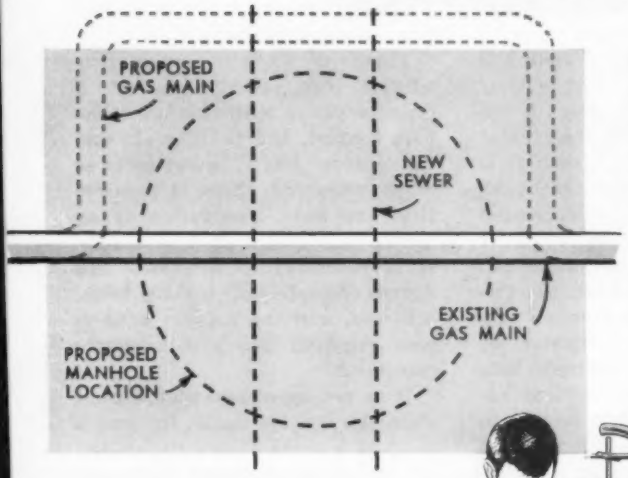
An example may clarify this procedure. Assume that a line protected by a single drainage point at one end has been adjusted to a P/S potential at the far end (low point) of 0.85 v, and that this requires a drainage current of 8.0 amp. Later it is observed that the current output is 10.0 amp; the question is, what is the current requirement now? Suppose that a P/S reading at the far end shows

Continued on page 91

RELOCATE GAS LINES QUICKLY and SAFELY with

MUELLER® NO-BLO® METHOD

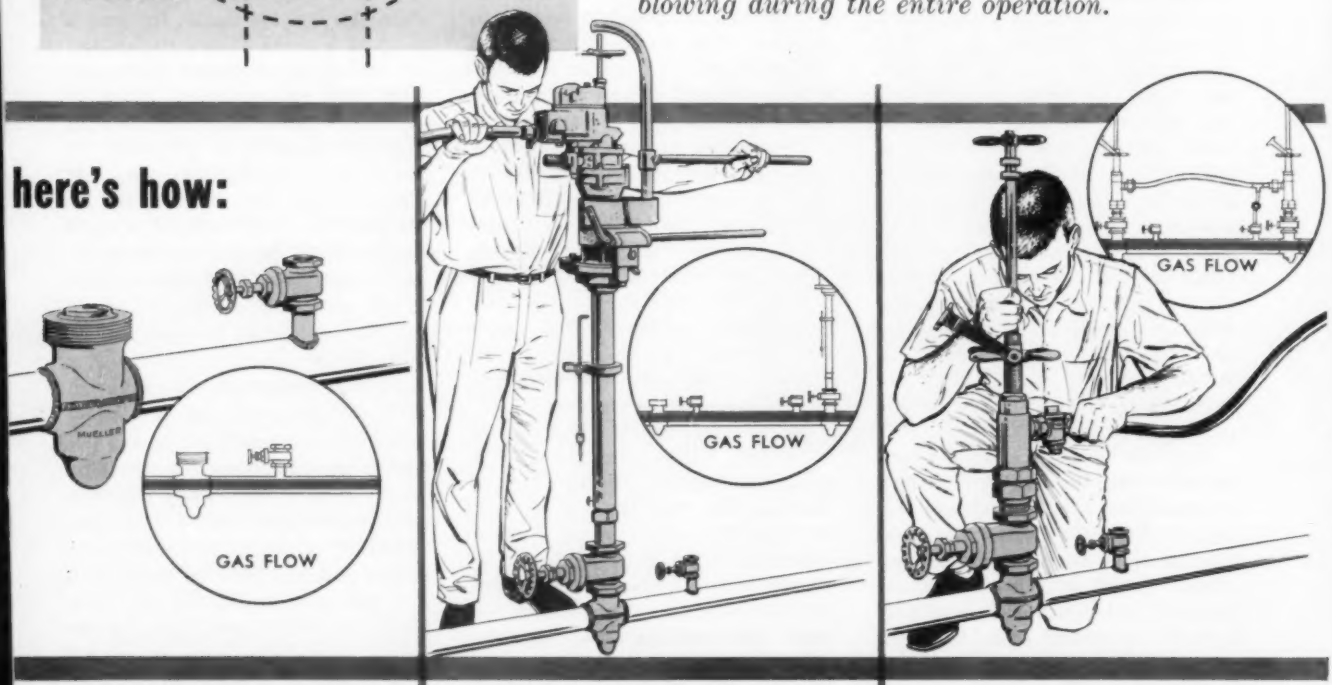
Machines and Equipment



■ Recently a new sewer trunk line and manhole installation posed a tough line relocation problem for a gas utility company. Serving an industrial and residential area, service could not be interrupted during relocation of the line.

This schematic diagram of the problem and the step by step illustrations show how the line was relocated with Mueller No-Blo Method Line Stopper Fittings and Equipment . . . *without interrupting service* and *without gas blowing during the entire operation.*

here's how:



STEP 1 ATTACH FITTINGS

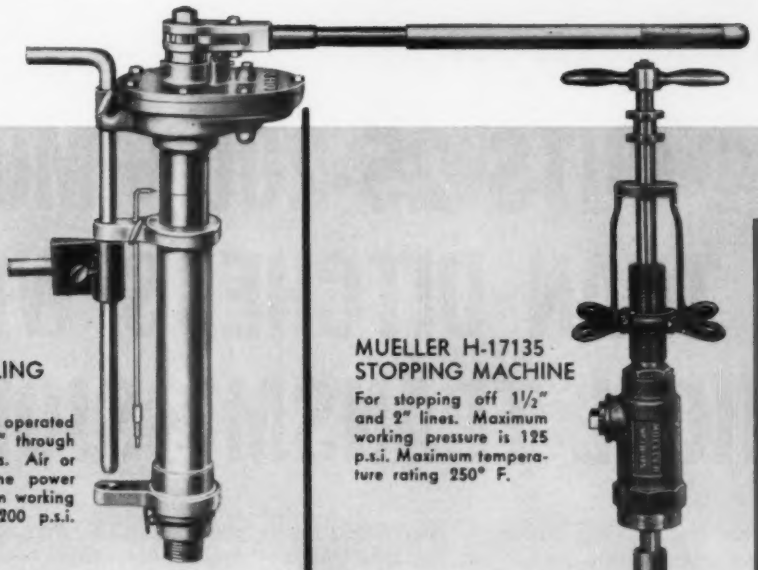
Weld Mueller Line Stopper Fittings to main on each side of section to be relocated. Weld Save-A-Valve Drilling Nipples to line providing by-pass and purging connections. Attach gate valves to drilling nipples.

STEP 2 DRILL MAIN

Attach special Mueller gate valve to stopper fitting. Attach DH-2 Drilling Machine (or D-4 Drilling Machine) to gate valve. Make cut, retract drill, close gate valve and remove drilling machine. Repeat cutting operation in second line stopper fitting and Save-A-Valve Drilling Nipples.

STEP 3 CONNECT BY-PASS

Attach line stopper to H-17135 Stopping Machine and attach Machine to gate valve. Connect by-pass line between the H-17135 Stopping Machines. Purge by-pass, then start flow through the by-pass line.



MUELLER DH-2 DRILLING MACHINE

Power or hand operated for drilling ¼" through 2⅛" diameters. Air or gasoline engine power units. Maximum working pressure of 1,200 p.s.i. at 100° F.

MUELLER H-17135 STOPPING MACHINE

For stopping off 1½" and 2" lines. Maximum working pressure is 125 p.s.i. Maximum temperature rating 250° F.

SAVE-A-VALVE DRILLING NIPPLES

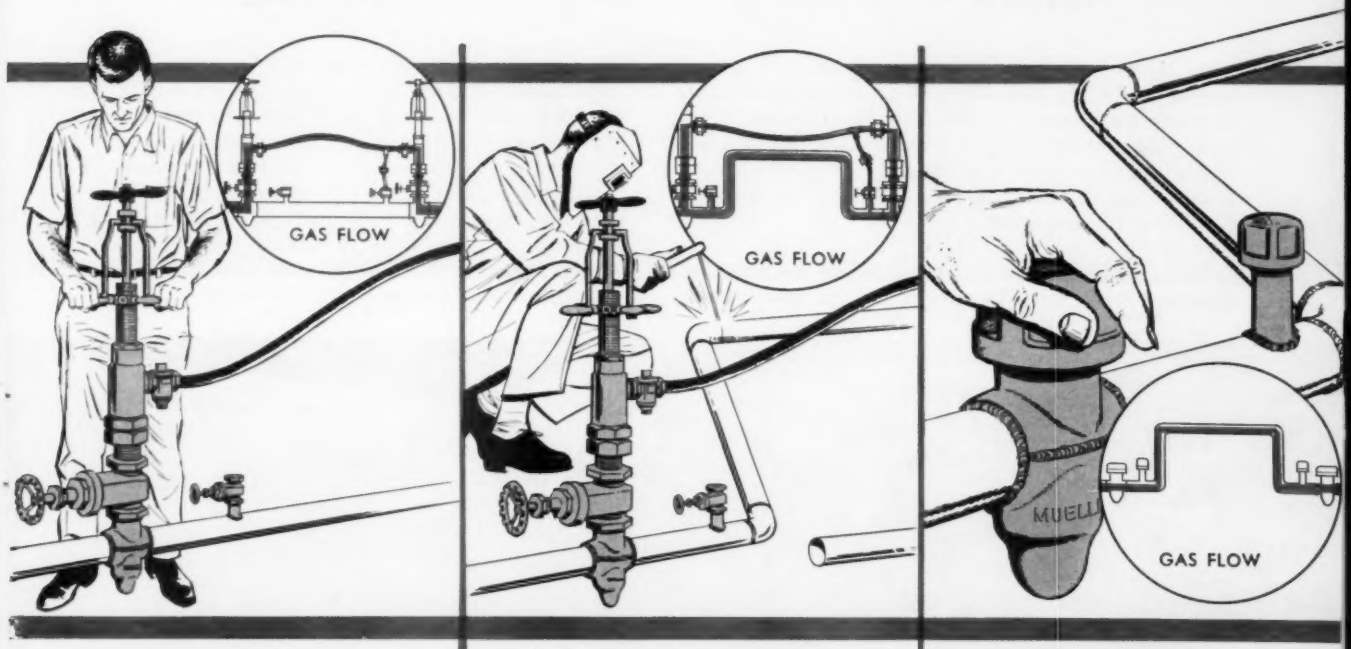
Welding or threaded inlet nipples available for 250 p.s.i. or 1,200 p.s.i. service. Sizes from ¾" through 3".

For complete engineering and No-Blo Method information, write direct.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario.

GEM Sponsor



STEP 4 STOP-OFF

Open gate valve on upstream stopper fitting, insert and expand stopper. Repeat stop-off operation on downstream stopper fitting. Section is now isolated.

STEP 5 RELOCATE MAIN

With by-pass line maintaining flow of gas without interruption or shut-down, the isolated section can be removed and relocated. Test new welds before activating new section.

STEP 6 ACTIVATE MAIN

Purge isolated main section after welds have cooled. Using Unit #1 Stopping Machine, remove line stopper in downstream fitting and close gate valve. Then remove line stopper fitting in upstream fitting. Main section is now in operation. Remove by-pass. Plug and cap line stopper fittings and drilling nipples.

Texas utilities contractor reports:

"OUR 774 CUTS 25-200% MORE TRENCH THAN DITCHERS WITH MECHANICAL TRANSMISSIONS"

"We know for a fact our Barber-Greene 774 Ditcher with dual-range Hydra-Crowd transmission cuts 25 to 200% more ditch daily than mechanical transmission ditchers we've used," says H. W. McCurley, of Pearson & McCurley, Beaumont, Texas, utilities contractors.

"Actually the 774 revolutionizes ditcher design with a hydraulic control system that gives the operator fingertip control of forward crowding speeds, boom hoist, discharge conveyor drive . . . all independent of wheel digging speeds. And our operator sure likes the instant dialing of maximum crowding speed for any ground condition.

NO PARTS REPLACEMENT—"In ditching 36,000 feet, we've had no parts replacement . . . never changed digging teeth, side cutters or gumbo cutting lips on fingerback buckets," he recalls.

This Texas firm bought its 774 after renting one from a contractor. Your Barber-Greene Distributor will take you to a job and show you the ditcher you are interested in so you'll get all the facts. Call him today.

Midwest utility company
OWNS FLEET OF OVER 25 BARBER-GREENES

This Barber-Greene dug in record time the street mains and over 300 services in one subdivision, keeping well ahead of the crew that was welding, wrapping and lowering in. Owned by a major midwestern gas utility, the Model 773 shown below is only one of the more than 25 Barber-Greene Ditchers in their fleet.

For close quarter operation, Barber-Greene's 772, identical with the 773 except for narrower track gauge and pad width, works within 19″ of side obstructions. All three utility ditchers have dual-range Hydra-Crowd transmission, exclusive digging wheel drive with fully guarded chains, automatic overload protection, shock-absorbing flexible drawbar, hydraulically driven spoil conveyor with rubber-impact rollers, and fewest wearing parts for minimum maintenance. Model 774 is available with 5½′ or 7′ wheels and cuts from 18-30″ wide. Models 773 and 772 trench to 5½′ deep and 10-24″ wide.

On jobs in Beaumont and Orange, Texas, installing pipe from 8″ to 16″, Pearson & McCurley's 774 with 5½-ft. wheel dug up to 2,500-ft. daily in tough gulf coast gumbo. "Has plenty of reserve to dig far beyond our daily needs," says Mr. McCurley.

Rubber-tired or crawler mounted Barber-Greene Vertical Boom Ditchers cut lowest cost trench from 5½″ to 24″ wide and to 7′ deep. Model 705-B, shown, digs to 4′8″ deep.

Manufacturer of the only modern ditcher line

Representatives in Principal Cities of the World

Barber-Greene BG

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Plants in DeKalb, Illinois..Detroit..Canada..England..Brazil..Australia

CONVEYORS • LOADERS • DITCHERS • ASPHALT PAVING EQUIPMENT

COOKING IN THE FIREPLACE was romantic but hardly efficient. Heat was slow, uneven, uncontrollable . . . iron pots and pans, heavy. Feeding the family was work!

BASIC . . . but better than ever today

GAS "BURNERS WITH BRAINS" in today's kitchen . . . most recent achievement of the gas industry . . . "feel" and control heat in pots and pans . . . make cooking automatic . . . a pleasure!

Throughout the nation the cast iron gas mains of 55 major utilities are still serving after over a century of profitable operation. Cast iron pipe's quality is no accident. In our case, we assure it by controlling every production step. From mine to finished product, every length of pipe is subjected to exacting tests. This added care along our line contributes to smooth, trouble-free performance in yours.
You can depend on U. S. Pipe. Its performance is built-in.

SERVICE IS BUILT INTO CAST IRON

- Standardized mechanical joints are bottle-tight for usual gas distribution pressures . . . and for all types of gas.
- Centrifugally cast pipe is tough, strong and uniform.
- Joint design allows for deflection during and after installation.
- Service connections are easily made.
- Long life a matter of record.
- No shortages. Cast Iron pipe is immediately available.

U.S. cast iron PIPE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

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A WHOLLY INTEGRATED PRODUCER
FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

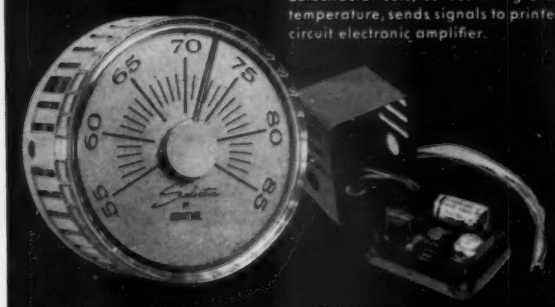
Dissatisfied homeowners . . . are taking notice . . . becoming buy-conscious

selecting furnaces . . . Selectra equipped . . . and enjoying true comfort

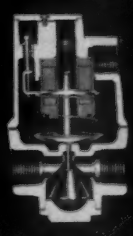
MAXITROL *Selectra*

MAXITROL COMPANY • 12200 BEECH ROAD • DETROIT 39, MICHIGAN

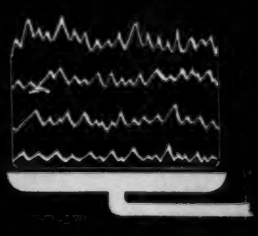
Selectrastat sets, senses living area temperature, sends signals to printed circuit electronic amplifier.



Selectra valve does double duty as a regulator and as a modulator in response to power output of amplifier.



Selectra infinitely modulates flame from full input to ⅓ input. It's not just a "full fire —low fire" system.



SEEKING SALES STIMULATION? THEN SELECT SELECTRA!

INSTALLATION IS A CINCH WHEN YOU CHOOSE CAST IRON PIPE

One of the reasons so many pipe experts prefer cast iron pipe is because it installs so easily—requires no coating or wrapping. As you see, the crew at the left is assembling the convenient lengths of cast iron pipe before trenching them—a particularly valuable time-saving operation when work crews must combat the handicap of wet trenches.

Besides being easy to handle, cast iron pipe is inherently rugged: it withstands all the usual stresses to which underground pipe is normally subjected; its modern mechanical joints remain tight under normal distribution pressures.

And tough cast iron pipe construction offers service-free dependability for years. Once in place, cast iron pipe stays there. In fact, 62 American cities are still using cast iron gas mains that were installed over a century ago.

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

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THE MARK OF THE 100-YEAR PIPE

Complete engineering and construction services for the gas industry

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Ten 20-ft. lengths of rigid pipe after being coupled. Two workmen did this job in only 20 minutes!

Workmen joining two sections of 1¼" rigid pipe.

ARIZONA PUBLIC SERVICE COMPANY SAVES 50% WITH

RIGID PIPE

made of ABS Plastic

RIGID PIPE GAS SYSTEM INSTALLATION OFFERS NEW PROOF OF SUPERIORITY OVER CONVENTIONAL TYPE

Big news for happy housewives in Gila Bend, Arizona—the convenience of gas utility service for the first time! Important news for utility companies everywhere—the 50% savings over cost of conventional pipe gained by use of Anesite rigid ABS pipe made of CYCOLAC throughout the system! Saved precious man-hours, too! Arizona Public Service Company completed the job in record time . . . insured a failure-free system with this lightweight, leak-proof, AGA-approved pipe. Another example of better service . . . bigger savings from rigid plastic pipe in vital municipal installations!

BE *ABSolutely* SURE . . .
INSIST ON RIGID ABS PIPE
made of
CYCOLAC®
THE BORG-WARNER PLASTIC THAT IS TOUGH, HARD AND CORROSION-RESISTANT

Write for the name of your nearest supplier

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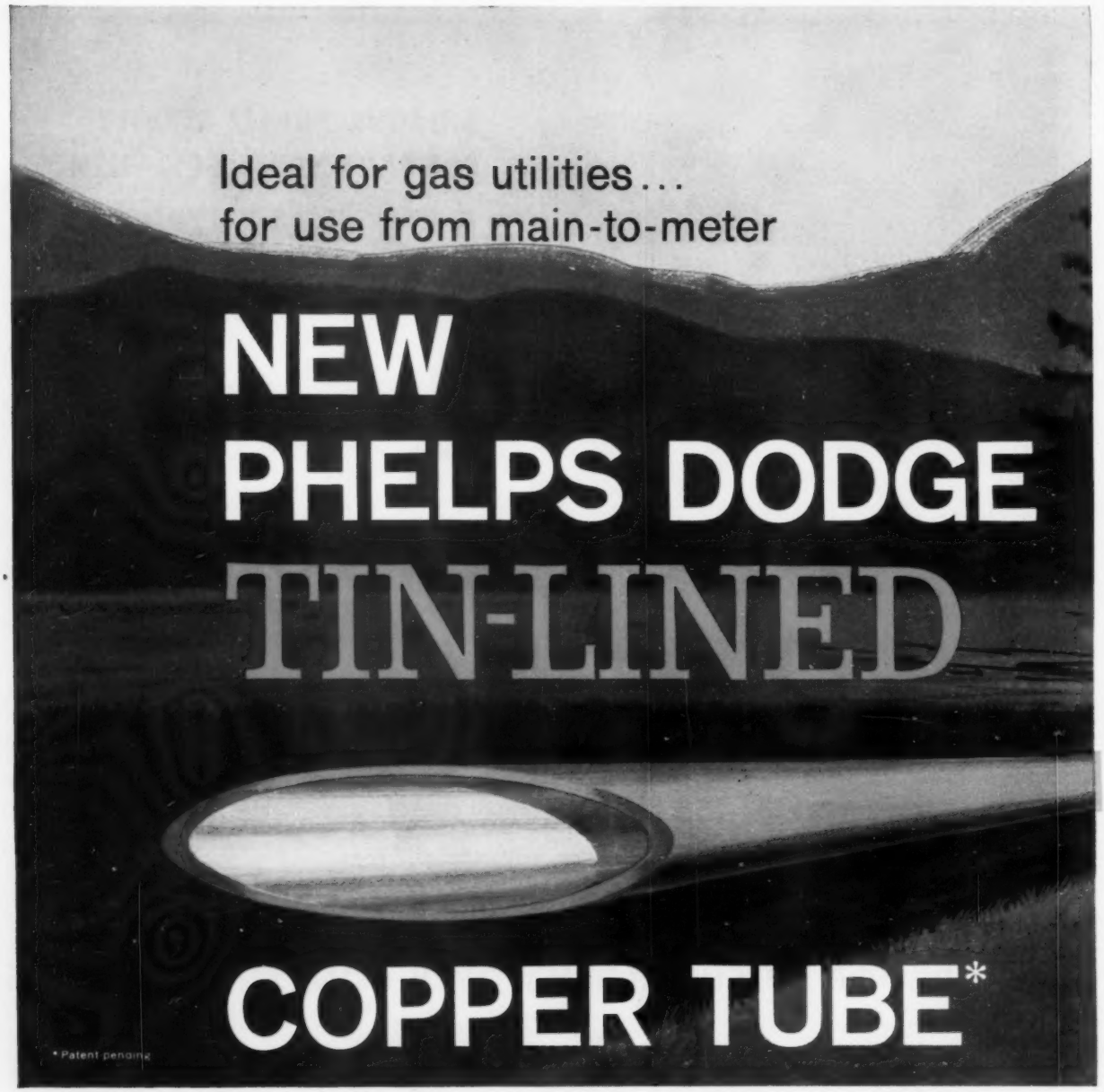

Phelps Dodge has combined the outstanding corrosion resistance of tin with the strength and ductility of copper in a new, low-cost tube that is immune to the troublesome sulphur conditions found in some natural gas and petroleum products. This tube has special advantages for gas utilities in main-to-meter lines, connecting lines to LP gas tanks, and for instrument tubing applications.

The continuous, inseparably-bonded, tin lining provides positive resistance to flaking action that can plug lines and orifices and create potentially dangerous hazards.

The tube can be easily bent, flared or soldered, providing "easy-to-use" features for every kind of gas installation, reducing labor costs.

Phelps Dodge tin-lined copper tube is ideal for replacement service, can be pulled through old steel or iron piping without protective wrapping. Available in long continuous lengths and in sizes

ranging from ⅛" O. D. to ⅝" O. D. Sample and descriptive data sent on request. Just write to the address below.

The corrosion-resistant, contamination-free properties of Phelps Dodge tin-lined copper tube offer distinct advantages for many other applications, including: oil lines; food-processing lines; beverage, pharmaceutical and water-distilling equipment; sampling lines to laboratory and control instruments.

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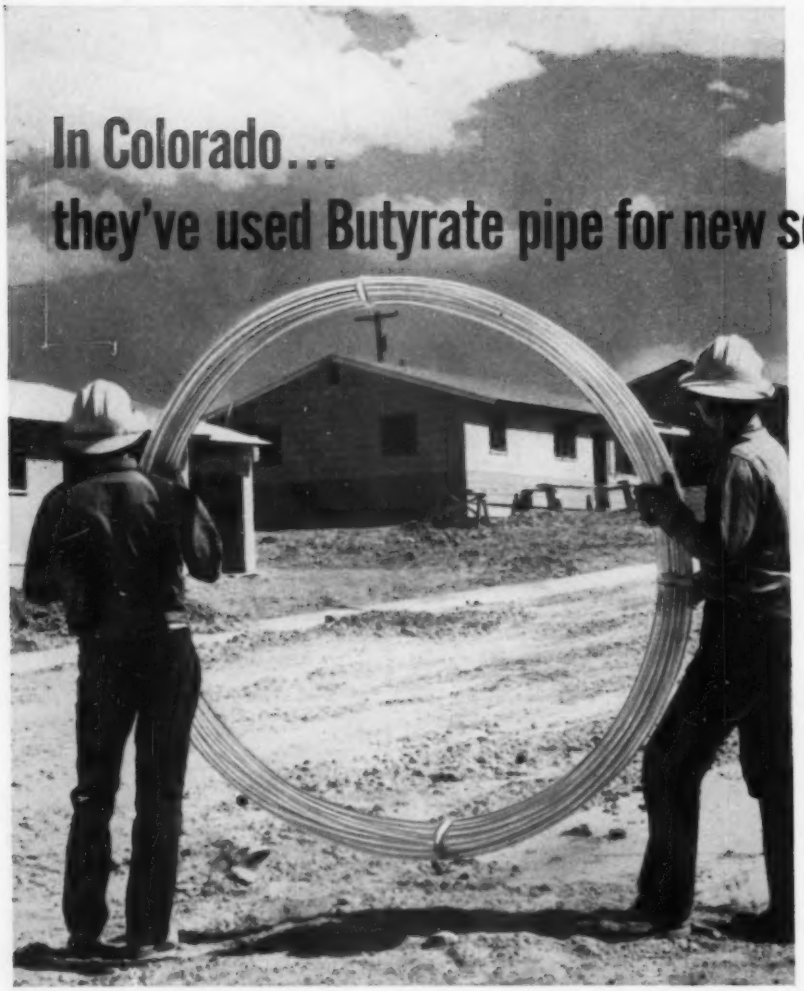
In Colorado... they've used Butyrate pipe for new services since 1951



A field crew of Public Service Company of Colorado installs a new service line using pipe of Tenite Butyrate. Butyrate's superior flexibility permits this pipe to be shipped in coils, which often means that service lines may be one continuous length with no plastic-to-plastic joints. (An AGA report recommends that only Butyrate pipe be shipped in this convenient manner.) Crewmen appreciate the ease with which lightweight Butyrate pipe may be handled. Plastic-to-metal joints are made quickly, and this tough pipe needs no "babying."

For nearly a decade, Public Service Company of Colorado has cut costs with service lines of Tenite Butyrate plastic

Public Service Company of Colorado is among the leaders in the current trend towards the use of plastic pipe in the gas industry. Its engineers first experimented with Butyrate plastic pipe back in 1951 and have been using it ever since, not only for service inserts but for new services as well. The fact is, *over 50% of the Butyrate pipe used by this utility goes into new services.*

The advantages of Butyrate pipe for new services go beyond the low initial cost and rapid installation. The corrosion potential of a system using Butyrate pipe is greatly reduced, resulting in substantial long-term savings in maintenance and better service to customers.

Since 1943, over 1,000 miles of Butyrate pipe have been installed by three major utilities alone. It's the first choice in plastic pipe among major natural gas distributors.

Investigate the many advantages of pipe of Tenite Butyrate for new service lines, service inserts or mains. For further information plus a list of extruders of Butyrate pipe, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

A 16mm. sound-color film, "Plastic Pipelines," is available upon request.

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BUTYRATE
an Eastman plastic

NEXT STOP... BAY BOTTOM!

American Molox Ball Joint Pipe Specified for Gas Installation

"Our experience with underwater installations caused us to select Cast Iron Pipe . . . AMERICAN Molox Ball Joint pipe," says one distribution engineer for an outstanding West Coast gas utility. The above view shows workmen assembling 10" AMERICAN Molox Ball Joint pipe on board the construction barge, part of a 3,500-foot underwater gas supply line. The 96-foot sections were lowered with the aid of a strongback for assembly beneath the surface.

Specify rugged AMERICAN Molox Ball Joint pipe for river crossings and other difficult underwater installations. Molox pipe affords maximum installation economies because it is easily adapted to several installation methods: It can be floated or pulled across streams, or can be installed directly on the bottom from a barge. Once laid, it remains bottle-tight at any angle. The joint is designed for deflections up to 15°.

Before "plunging" into underwater pipe installations, consider these and many other advantages of AMERICAN Molox Ball Joint pipe. Write for free illustrated catalog.

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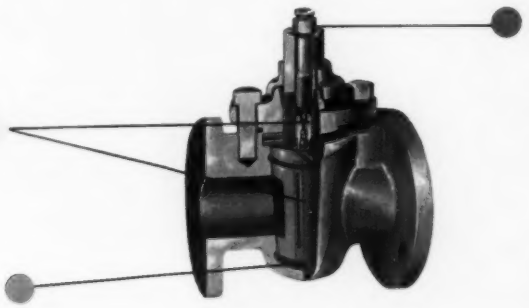
The Chinese had water distribution systems centuries ago. "Pipes" were sections of bamboo continuously spouting water. While date or inventor is not certain, one of the earliest valves was made by boring a hole in a plug and fitting it into holes cut in the bamboo pipe.

he stopped a trickle of water

. . . and his idea helped give you a better valve

One of the first known valves, a plug cock invented by the Chinese, had two inherent advantages never equalled by any other type of valve: *simplicity in construction and operation.* It controlled flow with only one moving part, the rotary plug.

To these basic advantages, the modern Rockwell-Nordstrom valve adds a third: *pressurized lubrication.* Pressurized lubrication totally seals the valve against leakage and maintains an instantly renewable seat. It also reduces wear and assures easy operation. And because there are only three basic parts – plug, body, and cover – you get longer life and lower cost–"The fewer the parts, the fewer the repairs." For more advantages of the Rockwell-Nordstrom valve, see the illustration below.



RUGGED DESIGN PLUS LUBRICATION SAVES MONEY

- Lubricant quickly, easily injected through Rockwell fitting.
- Lubricant travels through Sealdport® system to create powerful seals against leakage and prevent metal-to-metal wear between plug and body . . . note seats never exposed to the line.
- Lubricant hydraulically jacks plug minutely from seat for instant quarter-turn operation.

Rockwell-Nordstrom is the original and world's most complete line of lubricated plug valves. Available in sizes from ½" to 36" and pressures to 15,000 lb. For additional information, see your supplier or write: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania. Canadian Valve Licensee: Peacock Brothers Limited. If you live outside the USA, write: Rockwell International S.A., Geneva, Switzerland.

Lubrication Makes The Difference

ROCKWELL-Nordstrom VALVES

another fine product by

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"When we invited our people to join, our participation jumped 20%!"

"Early last month I checked with our Payroll Department. I found that less than 28% of our employees were enrolled in the Payroll Savings Plan. So I contacted our State Savings Bond Director and asked for his help and advice.

"He worked out an effective plan by which every person in our company was *invited* personally to join the Plan. You know, sometimes you hesitate to do a thing like this. Employees may think you are trying to use a little pressure. But the way we did it, there wasn't any pressure at all. We just explained the advantage of this systematic way of investing, and showed how convenient it is. Then we invited them to join with the millions of other Americans who are building personal security—and strengthening our country's peace power—through Savings Bonds. As a result we have better than 45% of our staff enrolled, and our participation is improving every payday."

Is *your* company enjoying the advantages of a substantial participation in the Payroll Savings Plan? Other first-line companies find that helping their people save regularly in U.S. Savings Bonds reduces employee turnover, improves safety records and steps up morale materially. If you'd like to see your company's participation increased, contact your State Savings Bond Director. He'll be glad to help you spread the latest information on Payroll Savings, person-to-person.

NOW! U.S. SAVINGS BONDS EARN 3¾%

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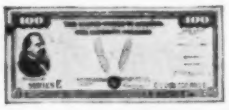

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Cleveland 140 digs 38-mile Idaho gas extension

Massart Construction Company of Spokane, Wash. used a Cleveland 140 to dig a 38-mile gas line eastward from Moscow, Idaho to serve a new refractory at Boville, another brick plant at Deary and smaller users along the line. The Cleveland dug the line 40 inches deep for 4 and 6-inch pipe at a rate of better than 2 miles per day.

Typical of the entire Cleveland Trencher line, the 140 provides over 30 non-slipping digging wheel speed-and-power combinations—a choice that gives maximum trench production in all soils and terrains with greatest economy for every type and size of digging within its range.

For gas distribution and service lines, for gathering and transmission lines... for pipelines of every kind... for water and sewer lines... for drainage and irrigation systems... for *every* trenching requirement... for dependability, speed and economy... nothing digs trench like a Cleveland.

Check with your distributor now—get the complete story on Clevelands

Good Everywhere

The CLEVELAND TRENCHER Co.

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with fast, expert 2-way radio service

The surest way to protect the peak performance you paid for is to take advantage of Motorola's convenient 2-way radio system maintenance. You get *factory supervised* service to keep your equipment operating to *factory standards.*

Wherever you are, one of the more than 800 authorized Motorola Service Stations is your "Johnny-on-the-Spot"—ready to provide *complete* system service tailored to meet your specific requirements. Join the thousands of 2-way radio users who are now enjoying peak performance—and substantial long-run savings—with a Motorola maintenance agreement.

For the best in mobile radio . . . and the best in mobile radio service . . . better contact the man from Motorola. Why not call today for full facts?

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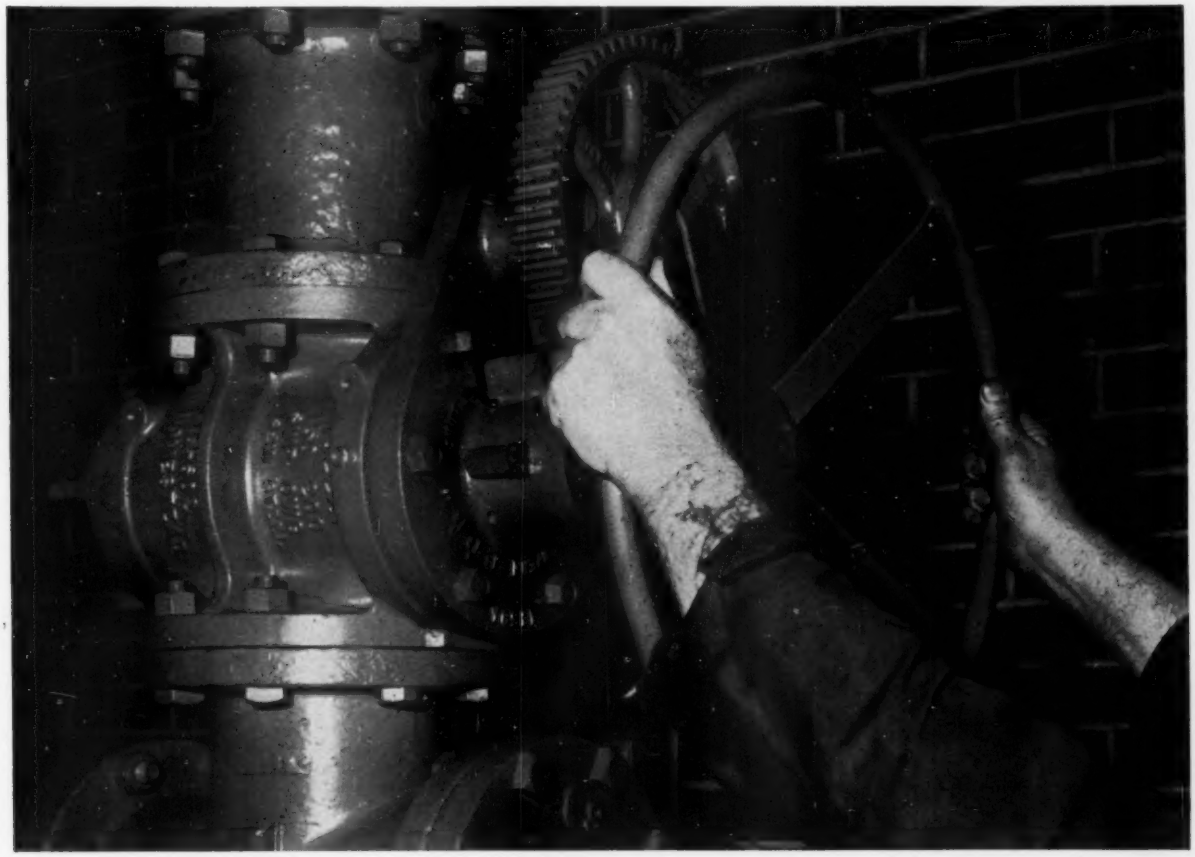
100% FLUID CONTROL AT YOUR FINGERTIPS

with Homestead Lubricated Plug Valves. When open, they provide full pipe-sized passage to fluids. Closed, their controlled high pressure lubricant



system, plus extremely close plug and body tolerance, guarantee a complete chemical seal—positive shut-off without contamination of line fluids. Instant response is sure, too, because piston-like movement of plug during each lubrication prevents sticking. They are low in first cost—low in upkeep. Write for complete details.

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HOMESTEAD VALVE MANUFACTURING COMPANY
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Gentlemen: Please send me Catalog 39-1 and prices on Homestead Lubricated Plug Valves 405

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Company.....

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NEW HANDLEY-BROWN

lifetime pipeline markers and sign posts . . .

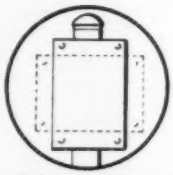
Never need painting. Won't rust or shatter!

This new, non-metallic* pipeline sign post saves money three ways. Chemically bonded color eliminates painting maintenance. The posts are light and easy to handle and store, come conveniently packaged 5 to a container. And they're sturdy, even gun shots won't shatter them.

Equally important, both pipeline markers and sign posts can be designed to meet your specific requirements. Marker posts and side-mounted sign posts may be equipped with cathodic terminal caps or vent caps. Climbers may also be added.

A 5" square foot piece is solvent-welded to the bottom of the post to prevent rotation. It anchors the post securely in the ground.

IT WILL PAY YOU TO GET THE FACTS FROM HANDLEY-BROWN. WRITE TODAY.



Side-mounted sign, (vertical or horizontal). Front view shown above.

Top-mounted pipeline sign post (vertical or horizontal). *Rear view shown above*

Marker Post with cap

Marker Post with vent cap

Cathodic terminal cap for pipeline marker post

End call backs with attractive H-B outside meter boxes. Available as shown, or for recessed installation. Made of tough resin-rubber compound*.

Master Poly-Trol *automatic* gas shut-off valve. Shuts-off gas in event of over-pressure, underpressure, excessive high temperature, and flooding. Serves also as a tamper-proof manual shut-off.

H-B Cathodic Terminal Box Landscape engineered, and non-corroding*. Leads are attached to the terminal block in the cap for easy testing.

Curb boxes—extension-type. Easy to find. Light. Tough. Safe. Made of resin-rubber compound*. Non-corroding, collapsible type. Equipped with permanent magnets—fast action on finders. Roadway valve boxes also available.

Service Test Station. Provides a test station for leak surveys. Permanently installed. Makes random probing unnecessary. Made of tough resin-rubber compound*.

specifications:

Post Length: 7' (other sizes available on request)

Post Diameter: 3½"

Wall Thickness: 3/16".

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HANDLEY-BROWN CO.

2102 BROOKLYN ROAD • JACKSON, MICHIGAN

JAEGER ROTARY "75"

best small compressor buy on the market

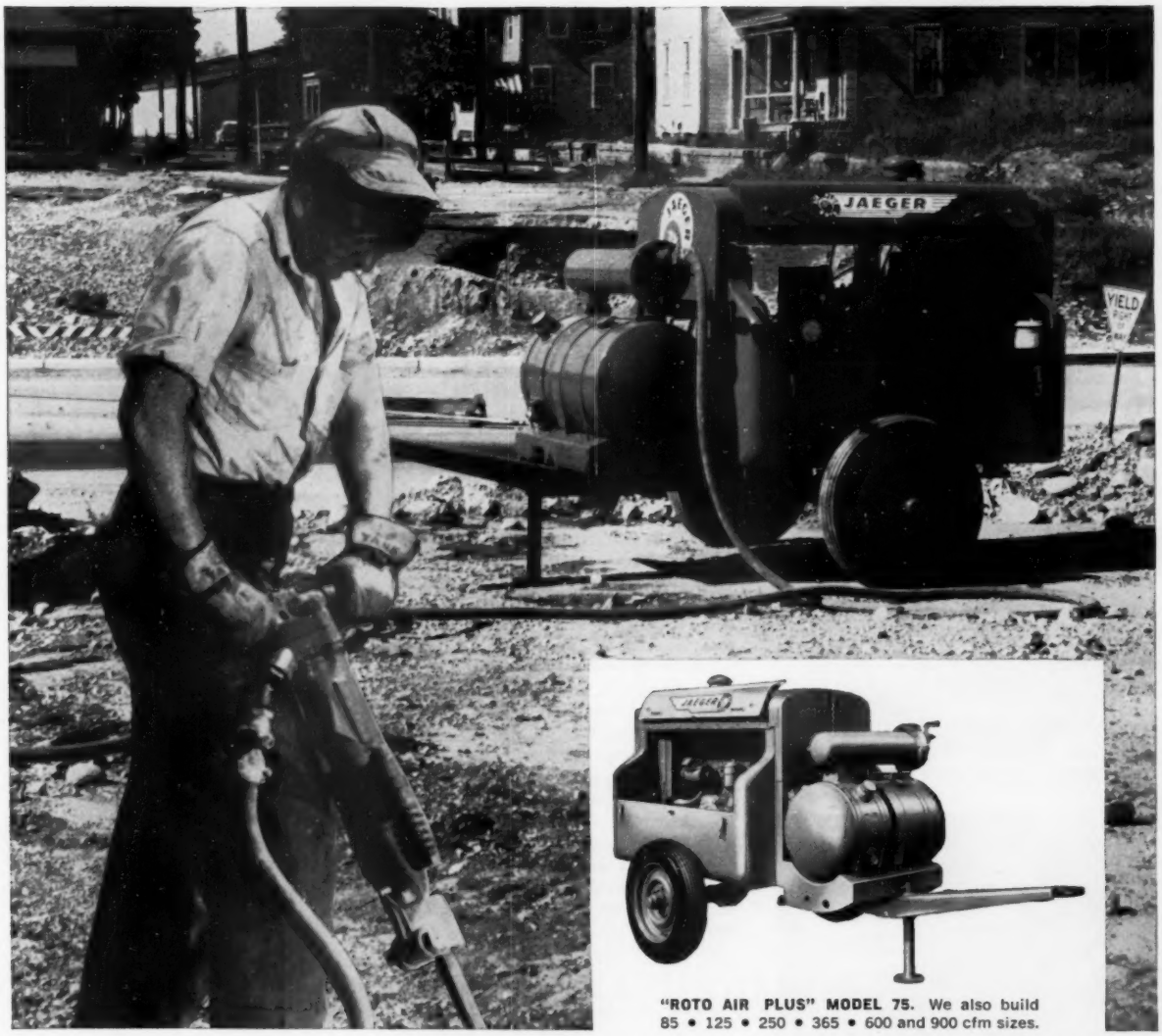
Costs much less than an "85" and is a better size for "one breaker" work.

Runs a heavy 80 lb. breaker at top efficiency (90 psig at the tool).

Always easy to start, because it's a rotary. No piston drag. Also smoother, cooler running than any reciprocating compressor.

Fully equipped with automatic blow-down valve; tool boxes big enough for full set of tools; spring-mounted, easy-trailing truck.

Save money, save fuel, speed your work . . . Ask your Jaeger distributor for price and specifications — or write us.



"ROTO AIR PLUS" MODEL 75. We also build 85 • 125 • 250 • 365 • 600 and 900 cfm sizes.

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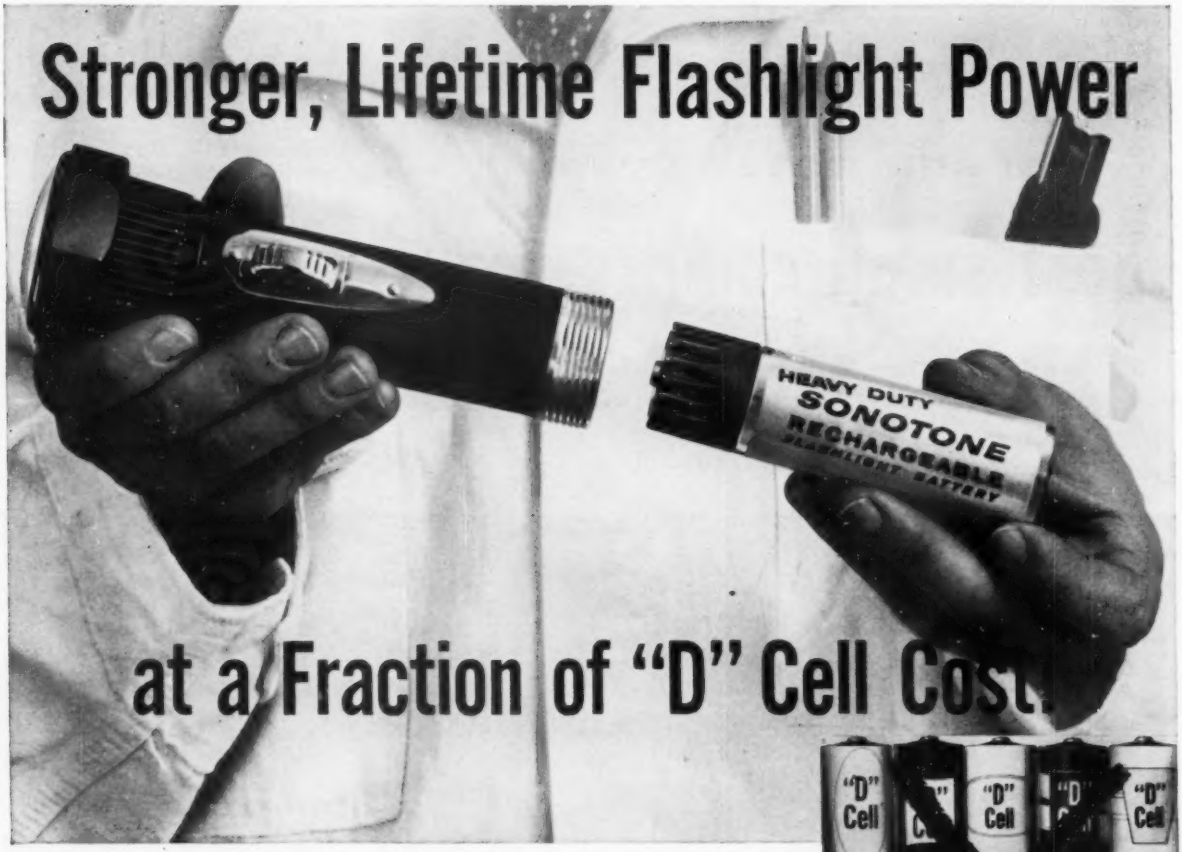
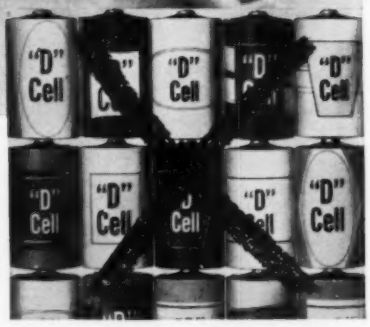
Stronger, Lifetime Flashlight Power



at a Fraction of "D" Cell Cost



Heavy-Duty Sonotone Rechargeable Flashlight Battery Cartridge

To recharge, just unscrew cap...

and plug overnight into any 110-120-volt AC outlet.

- **A multi-use adaptation of the patented Sonotone sintered-plate, nickel-cadmium battery used in space missiles and jets.**
- **Gives at least 3 hours of strong, continuous light from a single charge with PR-6 bulb—or 1½ hours with full-powered PR-2 bulb.**
- **Dependable in extreme temperature and weather conditions.**
- **Can be recharged hundreds of times at about ¼¢ per charge.**
- **Sturdy, leakproof construction—aluminum jacket—electrically shockproof.**
- **Full-year guarantee under heavy industrial use—backed by Sonotone's leadership of over 30 years in precision engineering and service.**

A completely new concept in flashlight battery efficiency and economy for industrial users! Replaces and outmodes any two "D" cells, for any purpose, in end-to-end use. Rechargeable overnight by plugging into any 110-120-volt AC outlet. Gives maintenance and service personnel a battery with a lifetime of use at a fraction of the cost of constantly replaced "D" cells. Dozens of applications—with railroads, aviation lines, municipal departments, public utilities and private industries. **Heavy-Duty Model FC-3** ($9.95 retail)—subject to your usual discounts. Also **Standard Model FC-2** for home use (light lasts at least 1½ hours with PR-6 bulb)—$7.95 retail. Write now for full details to:

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Battery Division, Dept. B49-60
ELMSFORD, N.Y.

Leading makers of fine transistor hearing aids, ceramic phonograph cartridges, speakers, microphones, electronic tubes, sintered-plate, nickel-cadmium batteries.

IN 1959, We learned some amazing facts about...

THE BOOMING PACIFIC NORTHWEST

Did you know that the normal summer temperatures in Seattle and Portland, largest cities in the Pacific Northwest, have the delightful range of 56° to 79°? Or that their winter temperatures are in the moderate 35° to 45° range? Or that annual precipitation in these booming economic centers is under 40 inches (less than New York City or Little Rock) with little snow?

The facts about the climate of Seattle, Portland, Spokane, Tacoma, Olympia and other Pacific Northwest cities were not a surprise to us. But we didn't know that Portland's winter weather was more moderate than in Louisville, Kentucky. We didn't know that Seattle's summers were cooler than in Portland, Maine.

In fact, when El Paso Natural Gas Company began to serve this dynamic region, we learned a lot of new things about a northwest wonderland destined for an increasingly major role in America's economic future.

Washington and Oregon, and their neighboring states, are on the go. Long famed for natural resources, for scenery, for vitality, the Pacific Northwest's growing population and expanding economy are a guarantee of future prosperity.

If you're looking for a major industrial site — or a better place to build a home — visit the Pacific Northwest. You'll be sold, just as we were. And you'll want to stay.

* * *

Not the least of the Pacific Northwest's economic assets is natural gas, furnished by El Paso Natural Gas Company. In 1959, El Paso took major steps to assure energy supplies for the Pacific Northwest, and to continue to meet the mounting energy demands of California and the Southwest, whose growth has paced the nation since World War II.

The dynamic Pacific Northwest is featured in photographs in El Paso's 1959 Annual Report. El Paso's broadened service area and plans for the future, outlined in this Annual Report, assure 11 Western states the dependable long-term gas supplies so necessary to sound and speedy economic growth.

NORMAL TEMPERATURE AND PRECIPITATION, SELECTED CITIES IN PACIFIC NORTHWEST*

	SUMMER TEMPERATURE	WINTER TEMPERATURE	ANNUAL PRECIPITATION
SEATTLE:	56°-75°	36°-45°	31.92 inches
PORTLAND:	58°-79°	35°-44°	39.91 inches
SPOKANE:	57°-82°	20°-30°	14.92 inches
TACOMA:	55°-74°	34°-44°	35.20 inches
OLYMPIA:	49°-76°	31°-43°	45.74 inches

*Weather Bureau, U.S. Department of Commerce.

EL PASO NATURAL GAS COMPANY

For Copies of El Paso's 1959 Annual Report, Or Further Information On the Pacific Northwest, Write to El Paso Natural Gas Company, El Paso, Texas

El Paso Natural Gas Company provides natural gas to industrial customers and distribution companies in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, West Texas and Wyoming.

THE *NEW* ROOTS 3000 cfh* GAS METER IS "JUST A BULGE IN THE LINE!"

*Size 3M125 1/2 actual size

Gas men who've previewed it are mighty excited about the cost saving features of the new Roots-Connersville 3000 cfh rotary gas meter. Only 14" long, a workman can pick it up with one hand and carry it under his arm.

Because it incorporates the famous Roots rotary positive displacement principle, accuracy is permanently locked in for the long, trouble-free life of the unit. Actuated by the gas flow itself, twin rotors displace a fixed volume of gas with each revolution, unaffected by variations in pressure or flow. Extremely close clearances between rotors assure accuracy while eliminating all friction and need for internal lubrication. Occasional replenishing of oil is the only maintenance required under normal operating conditions.

Here, is *the* efficient and economical way to meter industrial, commercial and institutional gas loads. Call in your Roots-Connersville sales engineer or write for complete data.

- **Replaces meters several times its size and weight**
- **Only 14" long—mounts in the line**
- **A bare 53 pounds**
- **Accurate to 3000 cfh and up to 125 psi**
- **Easily installed**
- **Direct reading or can be instrumented**
- **Quickly tested on standard equipment**
- **Virtually eliminates maintenance**
- **Requires no special supports**

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ROOTS
first in air and gas handling equipment

DRESSER INDUSTRIES, INC.
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GAS

JUNE 1960

Using MANAGEMENT SCIENCE to solve control problems

By ARTHUR H. SCHNEYMAN, Supervisor, Operations Analysis Group
Transmission & Distribution Dept., Washington (D. C.) Gas Light Co.

EVERY manager has at least two types of control problems: (1) bringing an uncontrolled situation or operation *into* control; (2) keeping a satisfactory condition *in* control.

An earlier article* suggests that management science—the blending of elements of management with the scientific method of problem solving—can be used to solve managerial problems of planning, organizing, directing *and controlling*.

The *scientific method* generally involves five steps: (1) define the problem; (2) collect and analyze data; (3) solve the problem; (4) test the solution; and (5) control the solution.

To use management science effectively for solving problems of attaining and maintaining control, an understanding of the management element of "control" itself is required, as well as familiarity with the scientific method of solving problems.

In this article, "control" as an element of management is discussed. In addition, a detailed case application of the scientific method to attain and maintain control over the *quality* of field production reports is reported. A future article will present a detailed study of control of the *quantity* of output of field crews.

This tool—the scientific method blended with an understanding of the philosophy of management control—offers alert utility managers a means for achieving control over operations.

Control: The Management Element

- **What is management control?**

To define the management element of "control" first requires an understanding of its interaction with the concept of goals and the "management-by-objective" principle from the element of "planning." Goals fall into three classes: (1) purposes; (2) objectives; and (3) standards.

Purposes—Businesses usually exist to: (1) make a profit; or (2) render a service; or (3) both. Purpose is the reason for existence of the firm. In any well-managed enterprise—and this applies to regulated types of business—every activity must make a positive contribution toward attainment of one or both of these purposes. This is the "management-by-objective" principle. Gas utilities deserve a "fair return on a fair value" provided they are managed well

* "Management Science Solves Utility Problems," Arthur H. Schneyman, GAS, January 1960, pp. 56-59.

enough to earn it! To manage well, one must control well.

Objectives—When purposes are refined by specifying general levels of desired attainment, they become objectives. For example, two general objectives of a gas utility may be: (1) to earn a 7 per cent return on rate base; and (2) to render better service than any competing fuel marketed in its franchise area.

Standards—When objectives are cast into specific quantitative or qualitative statements of those conditions which will exist when performance is satisfactory, they become standards. In its most comprehensive sense this is the real definition of a standard.

Actually, a complete hierarchy of *goals*, ranging from purpose through objectives to standards, exists in an enterprise.

Control—With this background, then, a definition of the management element of control can be formulated:

> **Management control is the process of guiding plans on course to attain and maintain enterprise goals (purposes, objectives and standards).**

• Feedback concept of managerial control

The feedback circuit—The basic concept of management control is the same as the simple feedback circuit shown in *Fig. 1* and used in control devices called servomechanisms. Gas utility people will recognize this concept in such well known devices as gas pressure regulators, room thermostats, and compressor and steam governors. The circuit works like this:

The goal, usually in the form of a standard, is stored in the memory unit. All or a portion of the output (A) of the system is measured by the monitor and fed back to the collator. The collator compares actual activity with the standard (C) and transmits the error (deviation, variance, difference) to the controller unit (B). The controller analyzes and takes corrective action to maintain the process on its goal.

The feedback circuit incorporating: (1) goals, (2) measurement, (3) feedback, (4) comparison, and (5) analysis and action, then, is the essence of management control and should be examined step by step.

Goals—Generally, the more quantitatively a standard can be stated, the better the control system. Standards for most practical applications of management control are concerned with control over the quantity or quality of an activity.

Quantity standards designed to control productivity are usually expressed as standard costs per unit or as labor time per unit of production. For example, dollars per foot or man-hours per job. Such production standards can range from mere statements of historical performance or economic desires (such as a budget) to more sophisticated statements of how long or how much of an expenditure it should take to conduct an activity.

Quality standards are often dictated by economic considerations and the level of service or product performance which management wishes to render. The acceptable quality level is often an economic compromise between the loss of sales, profits and reputation, on one hand, and the cost of building high quality into a product or service, on the other. Standards for quality of service are expressed in such terms as: hours wait before executing an order; number of

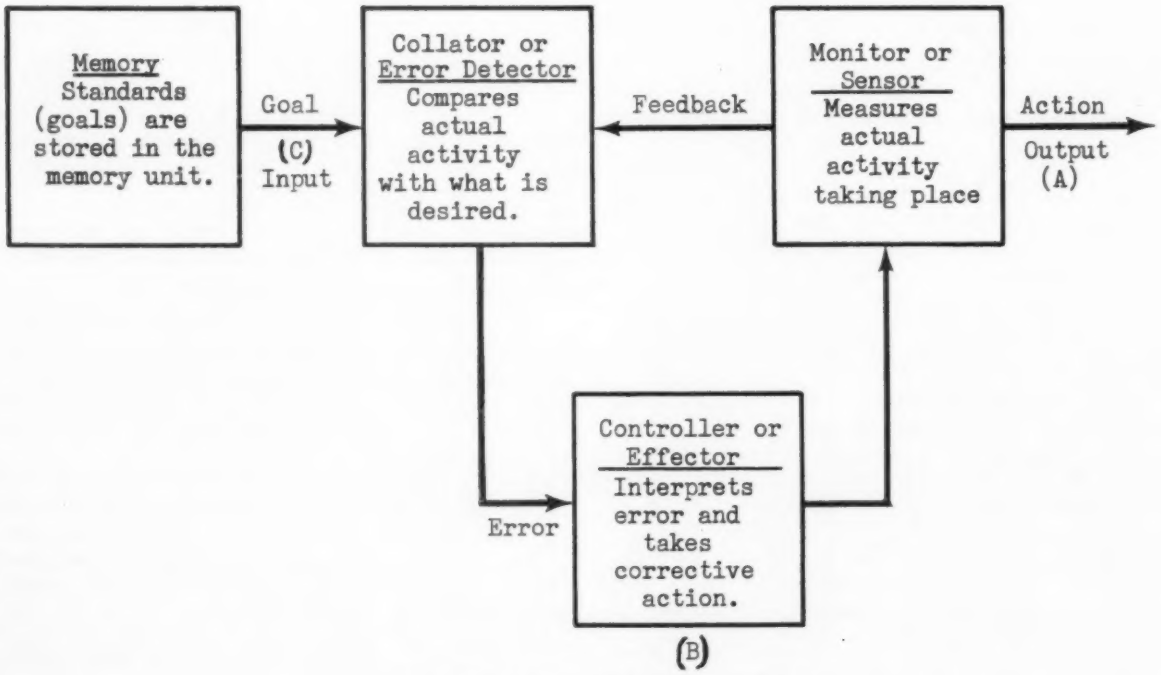

Fig. 1. The basic negative feedback circuit.

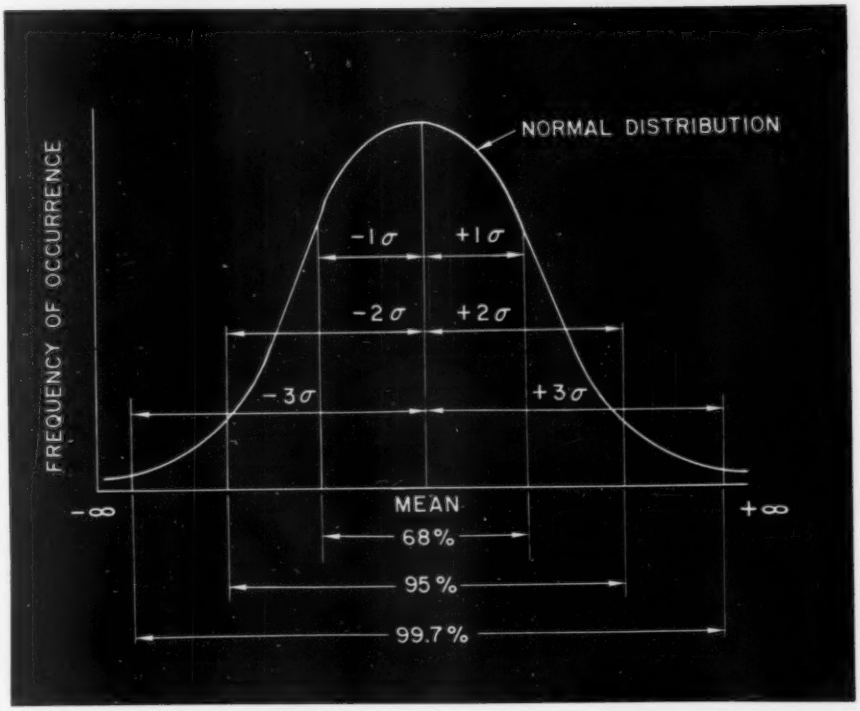

Fig. 2. Approximate probabilities associated with areas under the normal curve.

repeat calls for the same job; hours lost per breakdown; complaints per order; and the like. Product quality standards may deal with: number of errors per document; number of defectives produced; length of operating time to failure; etc.

Basically, the problem of setting standards boils down to a determination of what management considers as a satisfactory condition in terms of expenditures of resources that should be required to meet over-all goals.

Needless to say, the goals must be communicated to the controller unit. And, to keep the activity in control, the controller unit must be given the means to take corrective action.

Measurement and feedback—All of the output of the system, or a sample of its output, must be measured and fed back to the collator unit to see how the system is going. These measurements are usually numerical in nature and of two varieties (1) attributes, measures which can take on only one of two values, such as good or bad, pass or fail, accept or reject; or (2) variables, where the degree of acceptance or rejection can be indicated in more than two ways, such as length of time, number of hours, dimensions, dollar cost.

The reliability of these measurements is an often neglected but all-important step in an effective control system. If a sample of output is taken, it must be large enough and taken in such a manner as to give a specified degree of assurance that it is a dependable estimator of the whole process. The amount of error that can be tolerated and how frequently it can be permitted to occur must be specified.

The measurement process itself must be controlled to assure that the values generated are, in fact, what is happening. It may be necessary to set up a control system within the measurement step itself to guarantee that the data fed back is worth collating and analyzing in the first place, let alone serve as the basis for taking corrective action.

Comparison—Some degree of variability is inherent in every industrial activity. Feedback measurements of the same characteristics will not always be of the same value and can vary for a host of reasons, other than the fact that the process is out of control and needs adjustment. In almost every case where the goal is expressed as a single value, the collator will usually be detecting an error. Errors can fall on either side of the goal with equal probability, when pure chance is involved. The size of the error will require analysis and comparison with the inherent variability of the process before the performance of the system can be classified as satisfactory or significantly good or poor. This is done in the analyzer and controller unit. Naturally, all personnel associated with the controller unit, must be kept informed of the error data.

Analysis and action—Analysis of the error data must answer two questions: (1) Is the error of sufficient magnitude to really justify corrective action? and (2) If so, what is causing the variation and what action should be taken?

To answer the first question the inherent variability of the process either must be known or the allowable

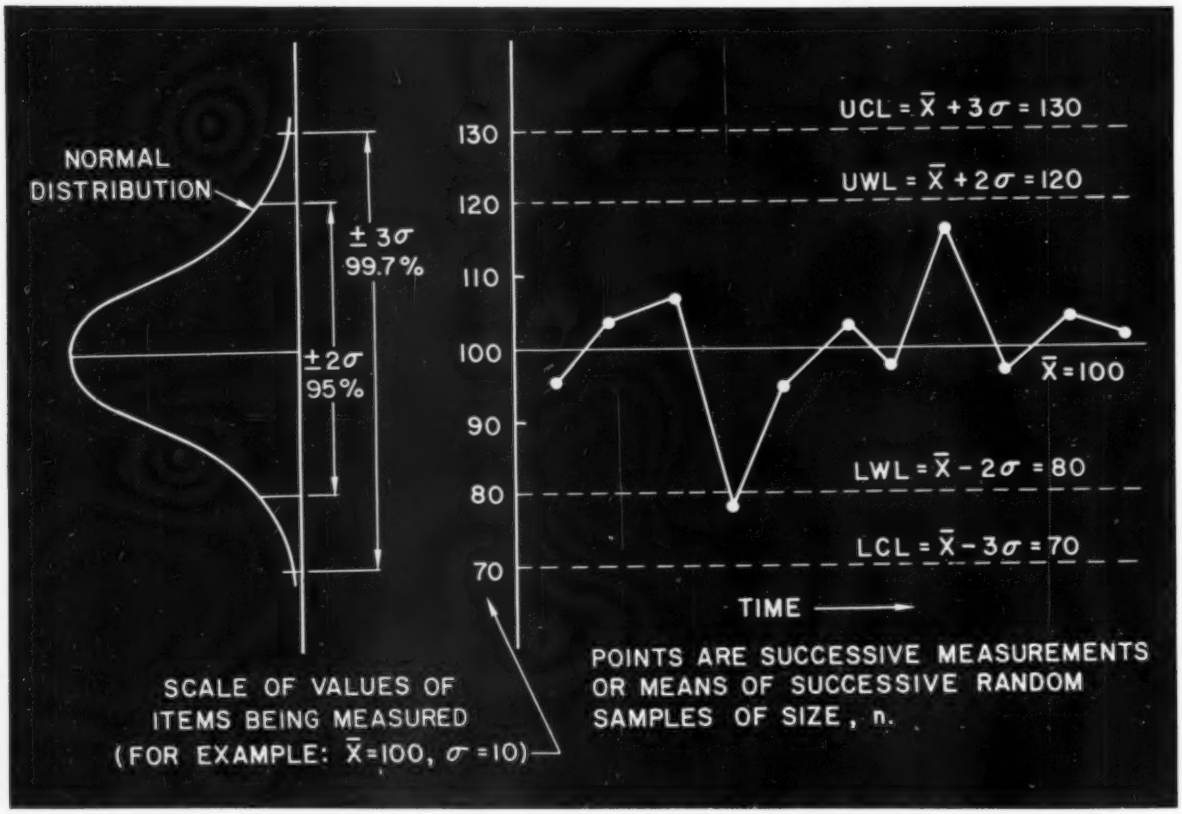

Fig. 3. Relationship between the normal curve and a control chart for means. This process is in control at the 3-sigma level.

variability of the process specified as part of the goal selection process. Probability statements are associated with process variability in such a way that the probability of an error of any magnitude occurring as a normal process fluctuation can be calculated. Management must decide how "fine" it wishes to control the process. For example, it may be decided to accept these inherent fluctuations which may occur, say, 95 per cent of the time. The error value, then, is compared against two limits within which 95 per cent of the expected errors will fall. If the error value falls outside either of these control values, management can be 95 per cent confident that this did not occur due to chance fluctuations in the process or sampling error. It is worthwhile, therefore, to search for an assignable cause, identify it and take corrective action.

Answering the second question requires a means for searching and sifting through all possible good and bad causes to isolate the real culprits or benefactors. Once the key causes are detected, the form of corrective action to be taken is usually apparent.

Satisfactory performance usually does not require any corrective action.

If the comparison is in the unsatisfactory performance area, action will be geared toward elimination or minimization of the causes in order to bring performance back into the satisfactory range. If a crew is performing poorly, for instance, the cause may be found to be poor job methods, lack of training, ineffective scheduling, improper work assignments, wrong crew size, faulty equipment, low motivation, personality conflicts, etc., and the corrective action would be aimed at alleviating the cause.

When the comparison shows excellent performance, efforts should be made to identify and perpetuate the causes. Such causes may be superior planning skill, job methods, effective use of equipment, optimum crew sizes and organization, high motivation, high morale, excellent communications, superior knowledge, and the like.

Obviously, the answers to these questions—"Is the error significant?" and "What causes are present and what action is required?"—hold the key to making managerial control pay off. The answers sustain satisfactory performance, reduce unsatisfactory performance, and enhance superior performance.

For this reason, the concept of the statistical control chart for detecting significant errors and what has been called the "vital few and trivial many," for analyzing causes, deserve special treatment.

• The control chart concept

The control chart is a record-keeping device for charting the pulse of the system. In addition to its historical value, it is used: (1) to signify when an error (or a performance) is significant; (2) to show when the nature of the process has changed; (3) to

predict serious trends or shifts in the system "before the damage is done"; and (4) to evaluate the effectiveness of corrective action taken. The effective manager will want to know how and why the control chart works.

Central measures and dispersion—In the control cycle the sensor really samples, out of the process universe, the key characteristic of the system's output which is to be controlled. This is the value which is fed back to the collator for comparison with the standard or goal value of the same characteristic. As time goes on, or by prior specification or by retrospective data gathering, these measures increase in number. Eventually enough sampled numbers are available so that an average or central value (or mean) can be calculated. Most of the numbers will cluster about the average. Fewer and fewer of the numbers will be found the further they are removed from the mean. If the spread of the numbers is very wide, a fairly loose and unpredictable process is recognized. Where the spread is tightly grouped near the central value, the process is thought of as being very stable.

The statistical quantity which actually estimates from the sampled numbers the degree of dispersion of the entire process about the mean is called the standard deviation and is often identified by the small Greek letter, sigma, σ. The standard deviation squared is called the variance, σ^2.

For variables data, the standard deviation, σ, can be readily calculated from either of the following formulas:

$$\sigma = \sqrt{\frac{\Sigma (x - \bar{x})^2}{n - 1}} \qquad (1)$$

or

$$\sigma = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n - 1}} \qquad (2)$$

where x = Each measurement

$\bar{x}$ = Mean of all the measurements, $\bar{x} = \frac{\Sigma x}{n}$

n = Number of measurements

For attributes data, the standard deviation of (standard error) the proportion of numbers having the characteristic in question, is:

$$\sigma_p = \sqrt{\frac{\bar{p}\,(1 - \bar{p})}{n}}$$

where $\bar{p}$ = Percentage acceptable *or* defective, as the case may be, expressed as a decimal. For example, a $\bar{p} = .10$ means 10% of the n items, say, passed.

n = Number of items in the sample.

Normal distributions—If the frequency of occurrence of each of the measurements (individually or in small groups) is plotted on a graph, the familiar symmetrical bell-shaped or normal curve usually results. If not, it is a statistical fact that taking the numbers in random samples of the same size and plotting the means of each sample, tends to approach a normal distribution, especially as the sample size increases.

TABLE 1. AREAS UNDER THE NORMAL CURVE

Number of Standard Deviations (Plus and Minus)	Approximate Percentage of Total Area	
	Within	Outside
$\pm 1\sigma$	68 %	32 %
$\pm 2\sigma$	95 %	5 %
$\pm 3\sigma$	99.7%	0.3%

The normal curve, therefore, is of such importance that some of its properties should be examined. It is completely specified by its mean and standard deviation. The area under the curve measures the probability of occurrence of each measurement. Since all measurements are contained in the distribution, the total area under the curve is 1 or certainty. The mean splits the area in half. Departures from the mean can be measured in terms of standard deviations and the associated area under the curve (probability) read from tables in most statistics textbooks. As shown in *Fig. 2*, the percentage of the measurements falling between plus or minus 1, 2 and 3 standard deviation are given in *Table 1*.

In the light of this brief statistical background, the control chart concept can now be examined.

Statistical control charts—Of the many types of control charts developed and in use, the "control chart for means" based on the normal distribution is the most common.

From the properties of the normal curve it is known that in a stable, controlled process it is expected that 68 per cent of the measurements made on the process will lie in the range between the mean and the plus and minus 1 standard deviation. Similarly, 95 per cent of the measurements are expected to fall between plus and minus 2 standard deviations, and so on, *provided the basic nature of the process does not change.*

When a measurement falls beyond 2 standard deviations, it is known that this will occur 5 per cent of the time *naturally*. If a cause, other than normal variations, is sought to explain this point, 1 will probably be found 95 times out of a 100 searches. Should the point fall beyond 3 sigma, this is expected to occur due to chance only 3 times out of a 1000 (99.7 percent of the time) and an assignable cause no doubt exists. If a point falls just beyond 1 standard deviation, it is expected to occur about a third (32 per cent) of the time normally and is usually not worth the effort to look for an assignable cause.

Most industrial and managerial control systems are desired to operate at the 2 or 3 sigma level. In a 3 sigma control chart the value corresponding to the mean plus 3 standard deviations is called the upper control limit (UCL) and the value at the mean minus 3 standard deviations is called the lower control limit (LCL). Often the 2 sigma limits are referred to as inner limits or warning limits on such a chart. *Fig. 3* is a control chart for means with a normal curve added to show the joint relationship.

Using the control chart—The controller unit is the

iogical step in the control cycle at which a control chart should be maintained. If the process has been in control, the central line is the standard or goal value. If the process is not in control at the standard value, the central line will show the mean value of the present output of the process.

Successive points in time are plotted on the chart and analyzed for assignable causes when falling out of control. If the corrective action is effective, succeeding points should be back in control or out for a different reason. Where the chart is being used to bring a process into control, the arrangements of the points can be used to detect shifts in the process average and the probability of such a shift occurring due to chance only calculated from the binomal expansion. *Table 2* gives some typical runs of points and their associated probabilities for detecting shifts in the entire process.

The case study in quality control presented later illustrates the use of the statistical control chart concept.

TABLE 2. CONTROL CHART RUNS AND ASSOCIATED PROBABILITIES

Description of Run	Probability[a] of Occurrence Due to Chance
In 5 successive points, all are on the same side of the central line	1/32 = .03125
In 8 successive points, 7 are on the same side of the central line	1/40 = .025
In 9 successive points, 8 are on the same side of the central line	1/51 = .0195
In 6 successive points, all are on the same side of the central line	1/64 = .0156
In 10 successive points, at least 9 are on the same side of the central line	1/93 = .0107
In 7 successive points, all are on the same side of the central line	1/128 = .00781
Of 2 successive points, both are outside the same 2-sigma limit	1/960 = .00104

[a] These are *a posteriori* probabilities which apply after the arrangements of points has taken place.

• The vital few and the trivial many

The concept of the "vital few" implies that: *a small minority of causes will contribute a major share of total effect.* When analyzing a number of independent causes or any set of circumstances, it is not unusual to find a vital few (5 to 15 per cent) of the conditions accounting for the bulk (70 to 80 per cent) of the total effect.

This concept can be seen in *Fig. 4.* All items are

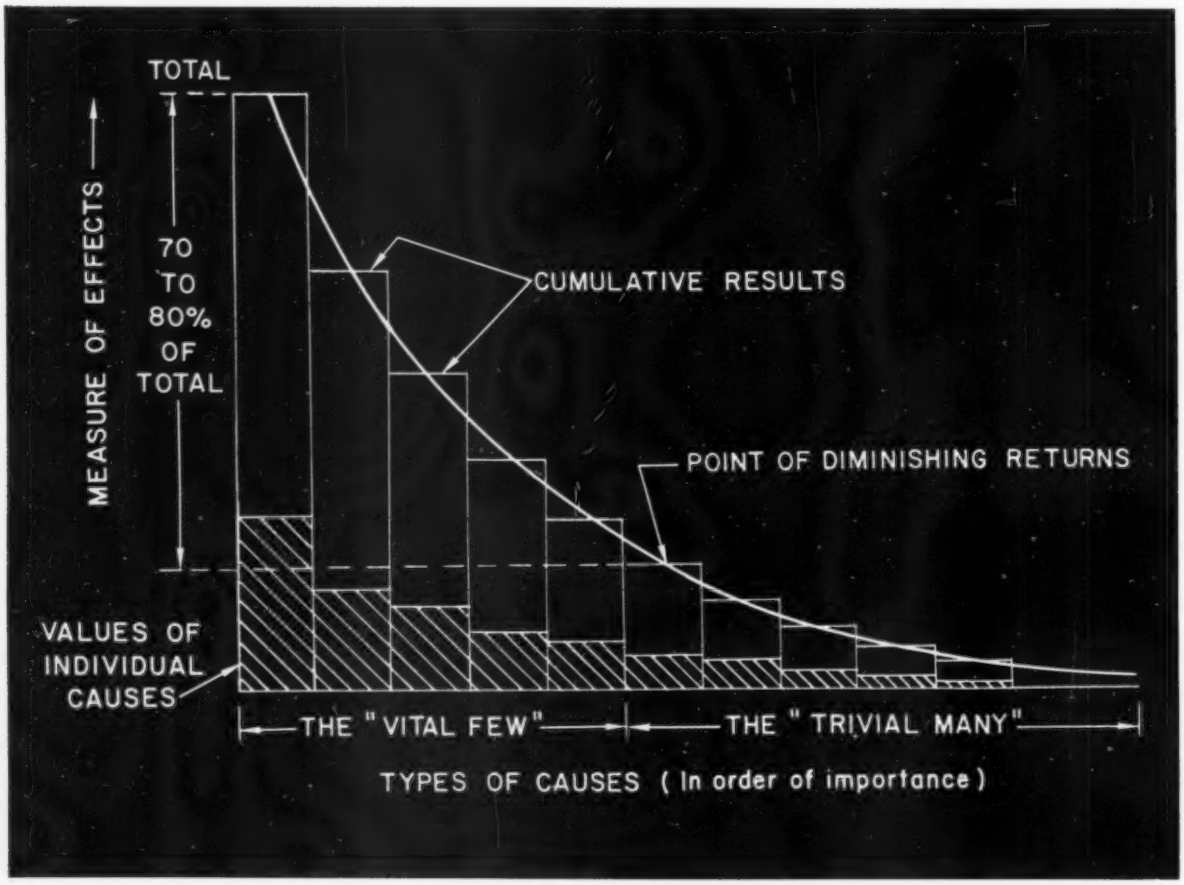

Fig. 4. The concept of the "vital few and the trivial many."

ranked in the bar-chart in order of contribution to the total effect. The extensions of these bars show the cumulative results. The point of diminishing returns sets in where a smooth curve through the center of each bar shows a pronounced change in slope. The coordinates of this point indicate the portion of the total effect caused by the "vital few" of the causes.

The importance of the vital few (particularly the most vital item) is further emphasized by the fact that the contribution of each independent cause to the over-all effect varies, not arithmetically, but with the square of the size of the cause.

Statistical theory (analysis of variance) tells us that the total variation is equal to the sum of squares of each component variation. Also, the composite of all causes is the square root of the total sum of squares contributed by each cause. Consider, for example, analyzing seven different kinds of errors found on a number of documents. The occurrence of these errors are ranked and distributed as in *Table 3*. If we cut the biggest cause of error in half, the square root of the sum of squares reduces substantially to 18.8. On the other hand, if the biggest cause is ignored and all of the remaining causes are completely eliminated, the composite merely reduces to 24!

The vital few, therefore, must be identified because nothing of significance will occur unless it happens to the vital few.

TABLE 3. SIGNIFICANCE OF THE "VITAL FEW"

Type of Error	No. of Errors Found	Square of No. of Errors	Reduce the "Vital One" in Half		Eliminate All the "Trivial Many"	
			No. of Errors	Square of No. of Errors	No. of Errors	Square of No. of Errors
A	24	576	12	144	24	576
B	12	144	12	144	—	—
C	7	49	7	49	—	—
D	3	9	3	9	—	—
E	2	4	2	4	—	—
F	1	1	1	1	—	—
G	1	1	1	1	—	—
Total Sum of Squares		784		352		576
Square Root of Total Sum of Squares		28		18.8		24

The following Washington Gas Light Co. case illustrates how the scientific method and the management control concepts of: (1) feedback, (2) control charts, and (3) the "vital few" were effectively used in controlling the quality of field reports.

Quality Control of Field Reports

ONE of the objectives of the transmission and distribution department is to control the costs of maintenance and service installation operations. As part of departmental efforts to achieve this goal, a work measurement program based on the feedback concept of management control was started. The measurement phase of the feedback circuit requires reports from field personnel (foremen and crew leaders) concerning units produced and working time.

It was recognized early that control over the reliability of these data is a necessary ingredient for success. This case describes how this was done.

• Defining the problem

Objective—An objective of 100 per cent error-free production reports is both impractical and unnecessary in view of the inherent variability in production, standards, and techniques for reporting time. For purposes of this application, it was judged that an acceptable quality level (AQL) averaging no more than 5 per cent jobs-in-error was satisfactory. For purposes of detecting shifts in the process quality level a risk of no more than 2 per cent was selected (see *Table 2*).

The report form—The lower portion of the crew daily time sheet comprises the production report. For every job worked, a separate set of entries is made showing: (1) identification number of foreman or crew leader; (2) substation identification number; (3) designation of second level supervisor; (4) job code number; (5) basic crew size; (6) number of services completed; (7) number of units of measure completed; (8) total on-the-job man-hours, excluding foreman; and (9) crew travel time and number of moves. This information is written as a column of entries for each job as shown in *Fig. 5*. Each crew appears on a separate sheet.

The job location, description of work, account number and the detail of hours worked for each crew member are recorded on the upper portion of the sheet. The reverse of the form, also in *Fig. 5*, contains a listing of work descriptions with related account numbers, job code numbers and units of measure.

The completed forms are turned in daily and processed by electronic data processing equipment to show individual crew productivity performances, performances of various sets of crews, system performance, travel performance and assignment of jobs to non-optimum crews. These performances are compared on an actual and standard man-hour basis.

Definition of an error—Since all items in the column must be correct to adequately report a job, a column of entries was selected as the basis for measurement. In each column the nine possible types of errors were considered of equal weight and, for ease of data gathering, identified as A, B, C, D, E, F, G, H, and I types of errors (see *Fig. 5*). A mistake of omission or commission in any one or more of these items constitute a "column-in-error." "Per cent jobs-in-error," therefore, was defined as:

$$\text{Per cent Error} = \frac{\text{Number of Columns in Error}}{\text{Total Number of Columns Examined}} \times 100$$

The correctness of each of the nine items in any column can usually be determined by checking each item for accuracy and consistency within the time sheet itself by following a specified inspection technique.

Problem symptoms and background—The appearance of obvious inconsistencies on the summaries of production data raised questions as to the reliability of the field reports. Early in 1957 a random sample of historical reports was taken and inspected for reliability in accordance with the inspection methods and definition of error developed. The results indicated that much improvement in the present quality level was needed.

Training sessions in the correct manner of reporting production data were initiated and completed in June 1957. The quality of reporting was measured after training and found to be 34 per cent in error, which constituted a reduction in the previous error rate.

• Collecting and analyzing data

Sampling inspection—In July 1957, a continuous sampling inspection plan was initiated. A total daily sample of 25 columns out of about 400 columns was drawn from each day's batch of time sheets and inspected. The crews involved operate out of three different substations and their reports are processed in substation batches. To guard against the possibility of introducing a substation bias into the sample, the total daily sample is allocated to each substation in proportion to the number of crews operating at each substation. Breaking a sample in this manner is referred to as stratification with proportional allocation. Samples can be stratified and allocated in other fashions as well.

The crews to be sampled each day must be selected at random. To assure that each crew has an equal opportunity of being sampled during each substation cycle, the names of all crews at a substation are put in a bowl and drawn in a random order without replacement. After all crews have been drawn the names are returned to the bowl and the process is repeated.

Recording data—The sampled columns are inspected and any errors detected are corrected. The findings are then recorded according to foreman and crew leader on an Individual Inspection Record, and on a Daily Recap of Inspection (*Fig. 6*), for each substation and the entire sample. Both forms are shown in *Fig. 6*.

The "per cent error" for the day is also posted to a control chart so that trends will become apparent, out-of-control points identified and correction action evaluated. The control chart for means used for attribute data such as this is called a "control chart for fraction defective" or "p-chart." The central line, p, is the average quality level of the process, in this case, measured in terms of "per cent jobs-in-error." In July 1957, after initial training, p was 34 per cent and the control chart was started. The standard deviation of this proportion is calculated from equation (3):

PROOF TOTALS | EMPLOYEE | GANG TOTAL | O / S

DAILY PHONE CALLS		CODES										
EMPLOYEE LINE NO.	NUMBER PHONE CALLS											
1.		LEAD EMPLOYEE	1325	1325	1325	1325						A
2.		SUB-STATION AND SUPERVISOR	101	101	101	101						B
3.		JOB CODE NUMBER (SEE REVERSE SIDE)	171	112	171	121						C
4.		ACTUAL NUMBER OF MEN IN CREW EXCLUDING FOREMAN	3	3	3	3						D
5.		NUMBER OF SERVICES COMPLETED (USE ONLY ON 600,700,800 & 975 JOB CODES)	—	—	—	—						E
6.		UNITS OF MEASURE COMPLETED	1	3	1	1						F
		TOTAL ON-THE-JOB MAN HOURS EXCLUDING FOREMAN'S TIME	4½	6	3	6						G
		GANG TRAVEL TIME	½	—	½	½						H
		ESTIMATED REMAINING DAYS TO COMPLETE JOB	C	C	C	C						I

APPROVED _____ FOREMAN | CHECKED _____ FOR _____ TOTAL GANG HOURS | APPROVED _____ FOR _____ TOTAL GANG HOURS (APPROVER MUST SIGN AND ENTER HOURS IN INK)

ACCOUNTS AND JOB PERFORMANCE CODES FOR TRANSMISSION AND DISTRIBUTION MAINTENANCE AND CAPITAL (SERVICES) WORK

Job Code Description	Unit of Meas.	Account*	Job Code† Number
TRANSMISSION MAINS MAINTENANCE			
Surveys	Bar Hole	760.301	301
Other Than Surveys	Job	760.302	302
DISTRIBUTION MAINS MAINTENANCE AND OPERATION			
PUMPING DRIPS	Gallon	767.100	100
REPAIR BROKEN OR LEAKING MAINS			
Inst Sleeve, Clamp or Saddle 6" & Smaller	Sleeve	773.111	111
Inst Sleeve, Clamp or Saddle 8" & Larger	Sleeve	773.112	112
Other Than with Sleeve, Clamp or Saddle	Job	773.113	113
REPAIR LEAKING JOINTS EXTERNALLY			
Inst or Repl B.J. ... Smaller	Clam		121
Inst or Repl ...			

Job Code Description	Unit of Meas.	Account*	Job Code† Number
SERVICES MAINTENANCE (Continued)			
REPR OR INSP FIRE VALVE & CASINGS			
Install, Replace or Remove	Valve	773.331	331
General Survey	Valve	773.332	332
High Pressure Survey	Valve	773.333	333
Repair — Digging Required	Valve	773.334	334
Repair — No Digging	Valve	773.335	335
WORK ON OTHER SERVICE SHUTOFFS AND BOXES			
Install, Repair or Replace by Digging	Each	773.341	341
Repair or Replace Inside Cock	Each	773.342	342
Install or Replace Box	Box	773.343	343
Locate ...	...	...	344

Fig. 5. Portions of the daily time sheet. ABOVE: Production report section of daily time sheet. BELOW: Reverse side of daily time sheet.

$$\text{Per cent Error} = \frac{\text{Number of Columns in Error}}{\text{Total Number of Columns Examined}} \times 100$$

$$\sigma_{\bar{p}} = \sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}} = \sqrt{\frac{.34\ (.66)}{25}} = .095 \text{ or } 9.5\% \text{ error}$$

The 3-sigma limits are: $p \pm 3\sigma = 34\% \pm 3\ (9.5\%)$ or 5.5% and 62.5%. Similarly, the 2-sigma limits are 15% and 53%.

Portions of the control chart are reproduced in *Fig. 7* and may be used to follow the discussion of the analysis, solution and control phases of the problem.

Analyzing data—The process was then left alone in order to: (1) accumulate sufficient information for further analysis; and (2) observe for a trend toward continued improvement. After three weeks the process proved to have stabilized at the 34 per cent level as indicated by random fluctuations about this average. It was apparent that some additional action must be taken to further reduce the error rate to the 5 per cent AQL objective. The managerial control concepts of the "feedback circuit" and the "vital few" were called in to solve the problem.

- **Solving the problem and testing**

Starting the feedback circuit—The feedback circuit was started on Aug. 5, 1957, by announcing to all personnel concerned that: (1) a sampling inspection program was underway; (2) the training sessions had reduced the error rate to 34 per cent; (3) the objective was a max-

INDIVIDUAL INSPECTION RECORD

Name _____ Gang No. 55

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Date	Col. Insp.	Col. in Error	% Error	Cumulative Columns			Daily Analysis By Error Type								
				Insp.	In Error	% Error	A	B	C	D	E	F	G	H	I
6-25-57	2	1	50	2	1	50%							1		
7-10	3	1	33	5	2	40%							1		
7-24	3	0	0	8	2	25%									
8-2	1	0	0	9	2	22%									
8-14	2	1	50	11	3	27%			1	1					
8-22	1	0	0	12	3	25%									
9-3	1			13	3	23%									

DAILY RECAP OF INSPECTIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Date	Col. Insp.	Col. in Error	% Error	Cumulative Columns			Daily Analysis By Error Type								
				Insp.	In Error	% Error	A	B	C	D	E	F	G	H	I
10-21-57	25	1	4%	25	1	4						1			
10-22	25	3	12%	50	4	8				2				1	
10-23	25	3	12%	75	7	9						3			
10-24	25	1	4%	100	8	8	1	1	1	1				1	
10-25	25	4	16%	125	12	10			2	1			2		
10-28	25	5	20%	150	17	11			3	1	2	2	1		
10-29	25		11%	175	18	10			1						

Fig. 6. Types of inspection records maintained.

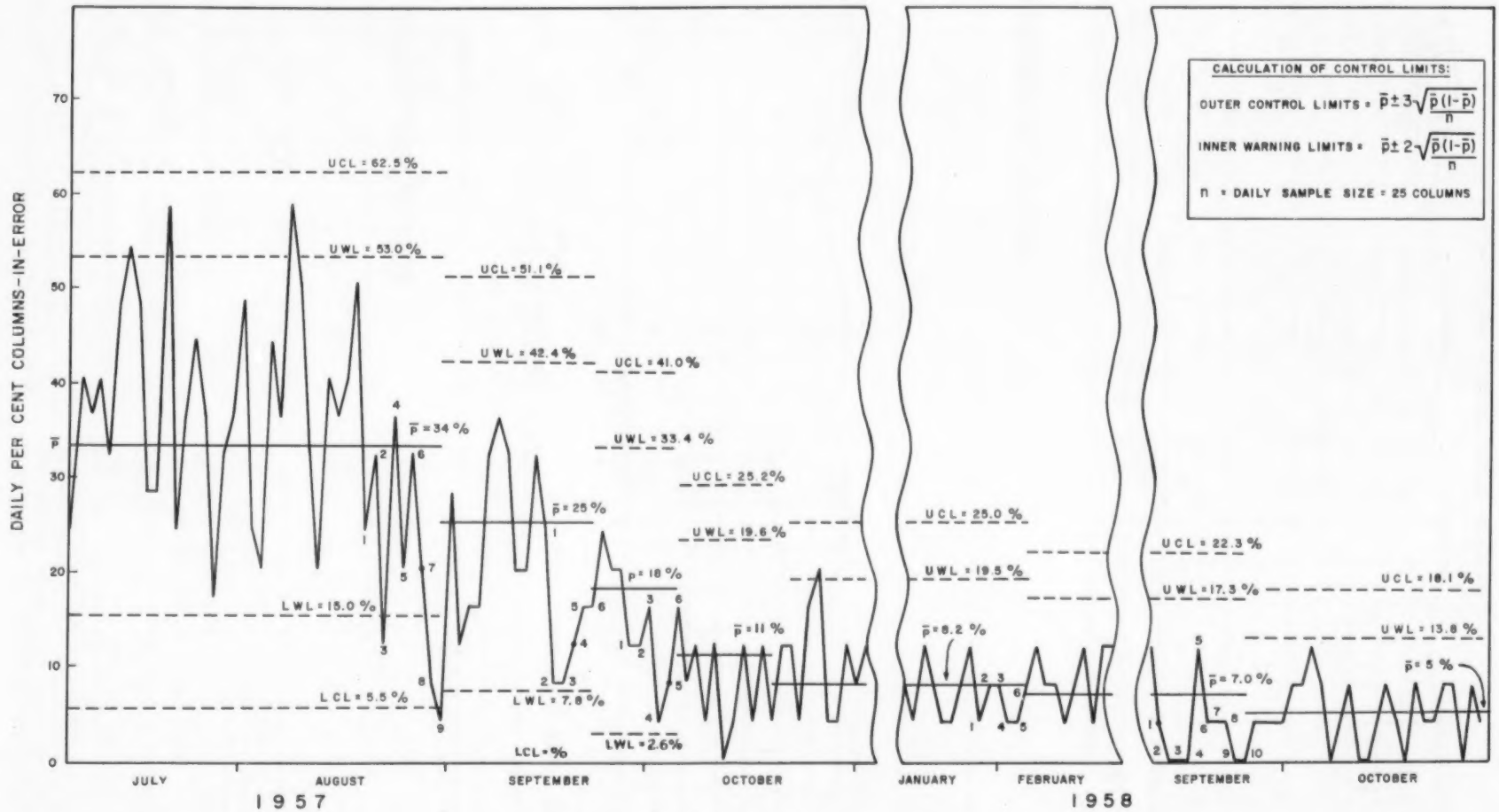

Fig. 7. Statistical quality control chart for per cent errors on production report section of daily time sheet.

imum of 5 per cent error; and (4) they would be kept informed of their own and over-all progress by a feedback of errors made, as well as when "no errors" were made.

A Feedback Form was used to convey the sampling results to the individuals. It consisted of a reproduction of the individual's entries with errors identified and a brief explanation of how it should be corrected. The feedbacks were prepared at the time of sampling inspection and routed to the individuals concerned through the various levels of field supervision. Usually, the individual received his Feedback Form within 48 hours after the time sheet was filled out.

After each individual had the opportunity to receive at least one feedback, a run developed of eight points below the 34 per cent process average out of nine successive points. Moreover, the 8th and 9th points were both below the 2-sigma limit. The probability of obtaining such a pair of points as these, by chance causes only, is one out of 960. The feedbacks probably account for this shift. The average of these nine points, 25 per cent, was then taken as a new process average.

Analysis by type of error—With approximately two months data available, an analysis was made by type of error. Of the nine different types of errors that can be made, it was found that two types accounted for 47 per cent of all errors. The first of these, box "G" or 24 per cent, was singled out and a set of "pointers" on the preparation of this box was sent to all concerned on Sept. 3.

The effectiveness of these "pointers" was evaluated by analyzing the distribution of error types for the 9-day period following release of this communication. This analysis revealed that box "G" now accounted for only 12 per cent of all the errors. In rank order, this box fell from first place to fifth place.

Error analysis by type of crew and substation—An analysis was also made at this time by functional type of crew and substation. It was found, for example, that one type of crew accounted for one-third of all the errors. The data indicated further that one particular substation was responsible for 44 per cent of these crew-type errors, or 15 per cent of all the errors.

This situation was discussed in detail on Sept. 4 with the general foreman of this substation. Armed with these data he set out to improve this substation's showing. In order to evaluate the effectiveness of this action, daily inspections were made of all crews at this substation for a period of eight days. Analysis of these data showed that of the total of 16 crews involved at this substation: (1) 11 crews showed a marked reduction in error rate, i.e., from an average of 69 per cent down to 23 per cent; (2) 3 crews remained at the same "good" level and (3) 2 crews grew worse.

On Sept. 19 "pointers" on preparation of the second most troublesome type of error (box F or 23 per cent based on original analysis described earlier) and a statement of the present p position were released. This memo resulted in a reduction of type "F" errors from 23 per cent to 19 per cent.

These last three actions plus the continued feedbacks resulted in a run of six successive points below the existing process average of 25 per cent. With 98.5 per cent certainty, a new process average (p) of 18 per cent was established on Sept. 24, based on this run.

A similar run, probably due to the same causes, developed several days later. On Oct. 7 a new p of 11 per cent was established.

Error analysis by individual crews—An analysis of all individual crews revealed that 10 of the 100 crews were primarily responsible for the error rate. These crews were inspected every day for a period of seven days and additional feedbacks sent to them.

Of the eight successive points between Oct. 8 and 17, five fell below the lower 1 sigma control limit. The probability of such an event due to chance cause only is one in 273 or about .4 per cent. With 99.6 per cent certainty a new p of slightly over 8 per cent was established. This change was probably due to the speed-up of error feedbacks on the poor performers plus any carry-over influence of previous actions.

Since correction of errors found at the time of inspection account for an additional 1 to 2 per cent reduction in error rate, hardly three months after the program was fully underway the quality of the outgoing production reports had been reduced to a 6 to 7 per cent error rate.

• Controlling the solution

Continued feedbacks, analysis, communication and evaluation of corrective action stepped the raw process average down to 7 per cent on Feb. 5, 1958, with a run of six points below the central line. Finally, in September 1958, a run of eight out of nine points indicated that the production reports were coming from the field at the objective 5 per cent error rate. The process has remained in control at this level ever since.

• Summary

Here we see management science in action. An administrative control problem was solved by the scientific method blended with the feedback, control chart and "vital few" concepts from the management element of control. ■

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This isn't the sort of breakthrough referred to in the headline. After receiving the full force of the 3½-ton weight dropped from 25 ft, this 16-in., 0.5-in. wall, regular-production-run pipe did not shatter. It merely dented and suffered a puncture from the tip of the weight.

Ductile iron pipe

On the brink of the big breakthrough?

By ROBERT CLAY • Managing Editor

ON a hot summer morning in August 1955, a construction crew began laying a gas main in downtown Chicago, near the then-brand-new Prudential building. To the casual passerby, it looked like just another pipe. For the gas industry, it was a historic moment, for this was the first operational ductile iron main laid in the United States. It was also the first time in more than 100 years that a new type of metallic material was used for gas piping.

This pioneering user of ductile iron pipe was the Peoples Gas Light & Coke Co. The mammoth Chicago-based integrated gas company had been searching for a pipe that would combine the established corrosion resistant properties of cast iron with the strength and ductility of steel. The material would not only have to withstand the strains placed upon it by frost, unstable ground conditions, etc.; but would also have to be tough enough to take hard knocks expected from construction crews working on foreign underground systems.

Peoples began investigating ductile iron. Its interest in the material reached a peak when its assistant chief technical engineer, Victor F. Bittner, visited France in 1953 and came back with a first-hand report of successful ductile iron pipe installations. The company immediately began working with an American pipe manufacturer to develop a product suitable for its needs. The success of that work is indicated by the fact that Peoples now has over 100 miles of ductile iron pipe in the ground, making it not only the first—but also the foremost—user in this country.

The rest of the gas industry has been much slower to accept ductile iron pipe. Chief reason for this is that veteran engineers are somewhat reluctant to substitute a material that is relatively new for a less expensive one that has been proving itself for more than a century, gray cast iron. This is all the more understandable when the engineer is aware that not only will he have to live and work with his decision for the rest of his life, but his successors will probably have to continue living and working with it many years after that.

Still, many things point to the possibility of a big break-through for ductile iron pipe in the not-too-distant future.

American Cast Iron Pipe Co., Birmingham, Ala., is probably this country's leading manufacturer of ductile iron pipe. It is also among the first, having initially cast ductile iron tubes in 1949. And it was the company that worked with Peoples to develop the pipe for that first ductile iron main. And, it has been a major ductile iron pipe supplier to the Chicago company ever since. Here's how a spokesman for American sums up the current picture:

"The use of ductile iron pipe for gas service is now only beginning to gain momentum. While Peoples has been the leader in endorsing ductile iron pipe for gas service, numerous other utilities have also purchased quantities, ranging from one carload to quan-

These before-and-after photomicrographs show the startling change that takes place in gray cast iron (left) when a small amount of magnesium alloy transforms it into ductile iron (right). Note how the long flakes of graphite break up the continuity of the surrounding material in gray cast iron, and form possible future rupture lines. In ductile iron, this same graphite appears in little balls which cannot act the same.

tities sufficient to cover an entire project. Two prominent midwestern gas companies have advised us that they are using American ductile iron pipe for new crossing runs under present or proposed highways. Numerically, the majority of American ductile iron purchases has been for pilot installations, many utility companies wanting to study the performance of ductile iron pipe under their particular conditions. In general, these customers are scattered throughout the territory we normally serve, which is from the Rocky Mountains eastward, including New England."

The only other American manufacturer known to be currently quoting delivery prices for ductile iron pipe is James B. Clow & Sons, Inc., Chicago. This company also supplies some ductile iron pipe to Peoples, but declines to comment on any phase of its customers' usage. A company spokesman, however, did say:

"Ductile iron will find large use in the gas distribution field."

This country's ductile iron production—for all uses—is zooming upward at a rapid rate. Production during 1959 rocketed 515 per cent to 40,000 tons from 1958's 6500 tons. And this year, it's expected to increase another 215 per cent, to 125,000 tons.

This production, of course, serves many, many industries in many, many ways. In the gas industry, ductile iron valves, regulators, and pumps are becoming familiar to all. Not as widely known are other gas industry uses for the material. Some of them are as prosaic as the plow (or its contemporary cousin, the bull-dozer which invariably has several ductile iron parts). Others are much more intriguing. Ductile iron, for example, made possible a new and improved reciprocating compressor for handling natural gas up to 2000 psi. No other commercially available material could provide the required strength along with the castability needed for the intricately cored compressor head. In another case, ductile iron's machinability, along with its good casting qualities, made it the ideal material for fan hubs used in gas compressor station cooling towers. How many other valuable uses this material will be put to within the gas industry in the coming years is anyone's guess. But it seems fairly certain that its usage will increase, if not actually enjoy a booming break-through. This, then,

Peoples Gas Light & Coke used

100 Miles of Ductile Iron Mains in Five Years

(breakdown shown is in feet)

LOW PRESSURE

	6-in.	8-in.	12-in.	16-in.	20-in.	24-in.	30-in.	Total
1955	1,041	—	—	—	—	—	—	1,041
1956	73,298	664	2,039	3,225	—	—	—	79,226
1957	145,755	2,518	4,644	16,028	2,127	—	638	171,710
1958	19,367	5,591	2,860	2,858	1,187	—	—	31,863
1959	105,698	2,022	731	6,883	484	—	—	115,818
TOTAL	345,159	10,795	10,274	28,994	3,798	—	638	399,658

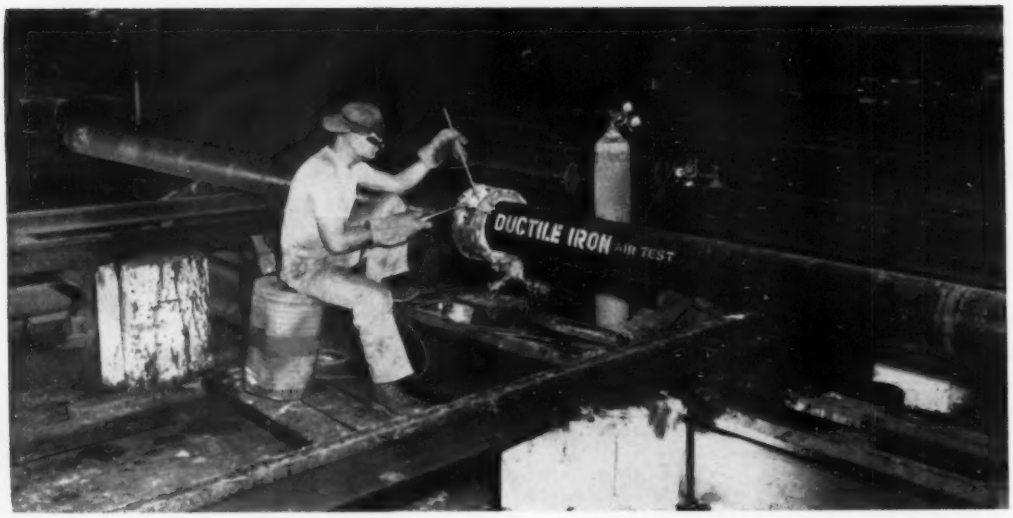
MEDIUM PRESSURE

	6-in.	8-in.	12-in.	16-in.	20-in.	24-in.	30-in.	Total
1955	—	—	—	—	—	—	—	—
1956	11,448	7,497	—	944		—	—	19,889
1957	27,355	2,530	4,215	12,335		841	—	47,276
1958	10,472	3,184	3,467	191	—	—	—	17,314
1959	22,961	5,856	4,736	11,484	3,119	—	—	48,156
TOTAL	72,236	19,067	12,418	24,954	3,119	841	—	132,635

HIGH PRESSURE

6-in.	8-in.	12-in.	16-in.	20-in.	24-in.	30-in.	Total
591	—	27	—	—	—	—	618

GRAND TOTAL 532,911



In the American Cast Iron factory, a worker fusion welds a pair of 16-ft ductile iron pipes into a 32-ft length for Peoples Gas. The longer sections enable Peoples Gas to push the pipe through bored holes under streets and highways, saving the cost of cutting and repairing road surfaces.

seems to be a good time to take a look at ductile iron.

What is it? Basically, it's standard gray cast iron transformed into a new material by the addition of a small amount of magnesium-bearing alloy. This startling change is brought about by an equally startling change in the material's microstructure.

Cast iron contains something in excess of 1.7 per cent carbon. (Steel contains less than 1.7 per cent.) In normal cast iron, this carbon or graphite appears in the form of randomly located flakes. These flakes break up the continuity of the matrix, or surrounding metal, setting up a series of microscopic planes which not only limit ductility but can act as rupture lines, when the material is placed under too much stress.

When the magnesium alloy is added, the microstructure undergoes the change indicated in the 100-times magnified samples shown on this page.

The graphite precipitates in spheroidal form (lumpy little balls). Because this shape allows the same amount of carbon to present a greatly reduced surface area, the continuity of the surrounding metal is not broken up as much as when the graphite is in flake form. Thus, changing the shape of the graphite particles makes ductile iron far stronger, tougher, and more ductile than ordinary cast iron. At the same time, it has the superior-to-steel machinability and corrosion-resistant qualities of gray cast iron.

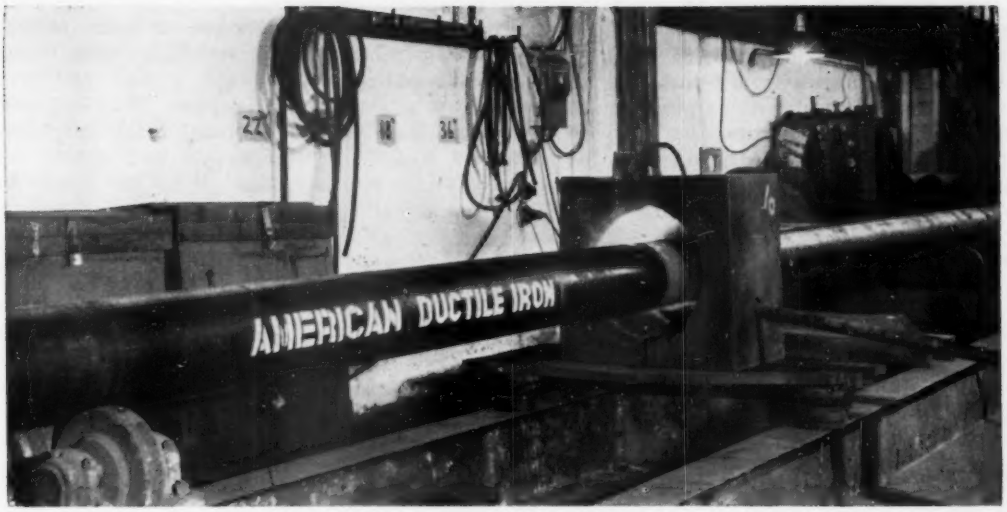
Ductile iron is manufactured in various types or grades. Most of these bear a numerical name indicating their properties. Thus, type 60-45-10 has 60,000 psi minimum tensile strength; 45,000 psi minimum yield strength; and 10 per cent minimum elongation. Other types are 70-50-05, 80-60,03, 100-70-03, and 120-90-02. The last three are normally for such things as gears, dies, and other wear and strength applications in various types of machinery, although 80-60-03 is also used for large diameter pipe. Two other types, heat resistant and high-alloy, are for special industrial applications, the latter most notably where high resistance to corrosion is needed.

Ductile iron is produced by foundries licensed under patents of the International Nickel Co., Inc. Standard specifications for ductile iron castings were adopted in 1955 by the American Society of Testing Materials. Manufacturers use a combination of ASA Specifications for Cast Iron Pipe Centrifugally Cast and the ASTM ductile iron castings specifications. Thus, there is a definite need for nationally recognized uniform specifications for ductile iron pipe.

Historically, there isn't too much about ductile iron. Less than two dozen years ago, a noted scientist concluded an address with the hope that "we may sometime even attain that ideal objective—ductile gray iron." Several years later, research men at International Nickel accomplished that seemingly far-away goal. Patents were issued and in 1948 domestic and foreign manufacturers began working on the production problems of ductile iron.

The first commercial ductile iron pipe was probably produced in France—at the Pont-A-Mousson foundries at Nancy. Ductile iron water mains were going in there during the early '50's. What is believed the first ductile iron gas line was also laid in France —along the Mediterranean Coast between the towns of Frontigan and Sete. Only 12,140 ft long, it was built to handle high pressure refinery gas for Gaz de France. The 6-in., threaded-joint line was designed for a working pressure of 425 psig, but was tested at 835 psig with gas and 1280 psig with water.

In this country, American Cast Iron Pipe began experimenting with ductile iron in 1948. The company's research staff made field trips to Europe to absorb the experience available there. Its people soon became experts on the material. One of the earliest technical papers on ductile iron production was published by C. K. Donoho, the American company's chief metallurgist.

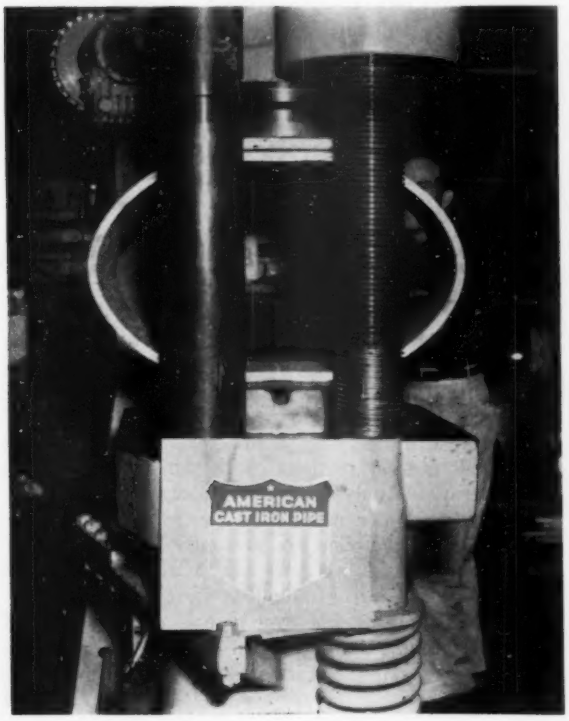


Here, the newly welded joint gets a post-heat treatment in a portable furnace to insure maximum uniformity of physical properties. Due to the desirability of this treatment, American does not recommend field welding, although it has no objections if customers want to weld connections.

The history of ductile iron pipe in the gas industry is primarily the history of Peoples' usage. The company's distribution system consists of approximately 4000 miles of pipe, varying in size from 2 in. to 48 in. Operating pressures in the system fall into three classifications: low, 6- to 8-in. wc; medium, 2- to 25-psig; and high, 25- to 80-psig.

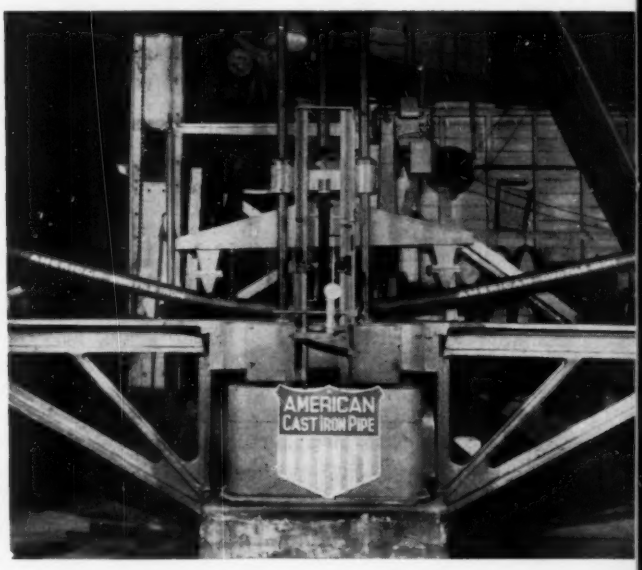
The five-year history of Peoples' ductile iron pipe installations is shown in the accompanying table, which indicates usage on a year-to-year basis, both by pipe diameter and by pressure classification.

Note that during the initial year, 1955, only 1041 ft of 6-in. were installed. Used in the low pressure system, this was 70-50-05 pipe and conformed to ASA Thickness Class Number 21, which—for 6-in. pipe—has a nominal wall thickness of about 0.35 in.



LEFT: This ring crushing test determines the modulus of rupture and modulus of elasticity of ductile iron pipe.

BELOW: This machine measures beam strength and deflection of ductile iron pipe under loads up to 200,000 lb.



(The company uses the thicker Number 24 grade when buying gray cast iron pipe.)

In 1956, Peoples continued to use 70-50-05 pipe, putting in nearly 80,000 ft in sizes from 6 to 16 in. in its low pressure system. In the medium pressure system, nearly 20,000 ft in the same sizes were used.

In 1957, Peoples switched to 60-45-10 pipe, which is now the accepted standard for general gas system usage. That year, the company installed the largest sizes of ductile iron pipe used to date, 600-odd ft of 30-in. pipe in its low pressure system and 800-odd ft of 24-in. in its medium pressure system. The year was also notable in that it marked Peoples' greatest usage of ductile iron pipe, over 171,000 ft in the low pressure system and over 47,000 ft for medium pressure use. Due to a shortage of ductile iron, usage dropped considerably in 1958, with 31,000 ft in low pressure and 17,000 ft in high pressure. However, it bounced right back up in 1959, with 115,000 ft in low pressure and 48,000 ft in medium pressure.

Thus, in the five years ending Dec. 31, 1959, Peoples laid 532,911 ft or 100.93 miles of ductile iron pipe. Exactly 75 per cent, or 75.7 miles, was in low pressure systems with the vast majority, 86.3 per cent, being in the 6-in. size. Medium pressure usage accounted for 24.9 per cent, or 25.1 miles, with 6-in. again the most popular size, accounting for 54.4 per cent of the pipe put in medium pressure service. The remaining 0.1 per cent, actually 618 ft, went into high pressure service, with the bulk of it again in 6-in. Taking all three pressure categories together, 6-in. pipe accounted for 417,986 ft or 78.5 per cent of all ductile pipe used. The second most popular size was 16-in., which accounted for 53,948 ft, or 10.1 per cent of the total.

Is Peoples satisfied? It uses the same basic installation techniques it has used for years with gray cast iron: standard mechanical joints either in open ditches or through tunnels under the streets. And, it reports "no breaks yet." However, it has had one problem, which was solved. Here's the way Peoples' engineer George F. Keenan describes it:

"On several occasions, when using large size ductile iron pipe—over 12-in.—Peoples encountered some oversize and out-of-round pipe when a standard full length had to be cut. Because of this, Peoples' inspectors while inspecting at the pipe manufacturing plants —use a split ring gauge to check for oversize and out-of-round along the total length of the pipe."

Inspections are also, of course, continuously carried out by the manufacturer. For a better understanding of his side of the picture, let's take a look at the operation of American Cast Iron Pipe Co.

American currently produces ductile iron pipe (and fittings) in sizes from 2 in. to 48 in.; in 12-, 16- and 20-ft lengths; and in three grades. Grade 60-45-10 is annealed ductile iron and is the grade normally furnished in pipe, tubing, and casing, in sizes up to 24 in. Grade 70-50-05 is a heat-treated material furnished on special order. Grade 80-60-03 is currently furnished in extra large pipe, tubing and casing. In addition, alloyed types are available for unusual conditions of corrosion or erosion. Also, 16- or 20-ft lengths may be factory welded into 32- or 40-ft section respectively.

American melts the base metal for ductile iron pipe and fittings in two separate types of basic (refractory) lined cupolas. An elliptical 72-x-102-in. diameter cupola equipped with water cooling and preheated blast produces iron for pipe. Thirty-six-inch water-cooled cupolas produce iron for fittings. Steel scrap and ductile iron returns are used almost exclusively in the cupola charge. Since the cupola is basic-lined, sulfur is easily kept below 0.04 per cent. Lump ferrosilicon is added to bring the silicon content up to approximately 1 per cent.

The alloying takes place in the ladle which transfers the molten metal to the casting machines. Magnesium-ferrosilicon is the standard additive. Proportions are measured by weighing. A 0.5 per cent cerium grade is used to counteract any contaminants which might impede the spheroidizing action of the magnesium. Plunging methods are also employed to introduce the magnesium-ferrosilicon into the molten metal resulting in a higher recovery of magnesium. Post-inoculation with calcium-bearing 85 per cent ferrosilicon is carried out to eliminate chill and the iron is then ready for casting.

The pipe is cast centrifugally in sand-lined steel molds or flasks, a process which rigidly controls the outside diameter of the pipe, yet permits the thickness of the pipe wall to be varied to meet service requirements. After it is removed from the mold or flask, the pipe is heat treated or annealed to a ferritic structure to insure that it meets the specified physical properties. As related on the accompanying specification sheet from American's ductile iron catalog, the pipe is then shot blasted on the outside, ground on the inside, machined where necessary, and coated, primed, sprayed, or lined as agreed upon at the time of purchase. The pipe is also tested, gauged, and marked, as spelled out on the specification sheet. Briefly, each pipe is hydrostatically tested at 500 to 600 psi, then submerged at 50 to 60 psi internal air pressure.

Throughout the manufacture of its ductile iron products, American continually conducts numerous routine control tests. To determine tensile and yield strengths and elongation, keel block test coupons are cast at intervals throughout each heat. Coupons are given the same heat treatment as the finished product. A test specimen is machined and subjected to a standard tensile test made in accordance with ASTM Specification A-339-55.

In addition, a number of other tests and inspections are made. Metallographic studies are regularly used to check the distribution and form of graphite particles and the composition of the metallic matrix. Rockwell and Brinell tests with both portable and fixed equipment are regularly made. Radiography checks welds and critical sections of certain castings while spectrographic analyses rapidly determine the chemical composition for production control.

Roughly related tests are presently being conducted by various utilities as more and more companies become interested in the unique properties of this wonder material. If ductile iron pipe is on the brink of a break-through, the successful results of these tests could send ductile iron sales curves right off their charts. ■

American Ductile Iron Pressure Pipe
For Gas Service

Section 1—Description of Pipe

The pipe shall be made with AMERICAN Double-X Mechanical Joints, Motox, Victaulic, plain ends, threaded and coupled joints, flanged or such other type joint as may be agreed upon at the time of purchase. Unless otherwise specified, pipe shall conform to the applicable dimensions, weights and tolerances of specifications listed below, which are approved by the American Gas Association:

American Standard Specification A21.9
American Standard Specification A21.11

Section 2—Quality of Iron

All pipe shall be made of good quality ductile cast iron, of such character and so adapted in chemical composition to produce spheroidal graphitic structure. The iron shall be of such character to provide superior mechanical properties of strength, toughness, and ductility, and shall be soft enough for satisfactory drilling and cutting. The iron shall comply with the physical specifications given in Section 8.

Section 3—Cleaning

All pipe shall be thoroughly cleaned before the application of any coating or lining. All pipe shall be ground on the inner surfaces after heat treating. All pipe shall have all scale from heat treating removed from the outer surfaces of the barrels to within 1½ feet of the bells by shot blasting or other approved methods. The gasket sealing surfaces of all sockets of mechanical joint type pipe shall be machined after heat treating.

Section 4—Coating and Lining

All machined surfaces and all gasket sealing surfaces shall be protected with a suitable rust preventive material. Unless otherwise agreed at the time of purchase, all pipe shall be furnished coated on exterior surfaces with a bituminous coating approximately one mil in thickness, the interior surface to be left uncoated. Special coatings, linings and oil-sprayed interior surfaces may be furnished when specified and glands will be furnished coated, unless otherwise specified.

Section 5—Testing

Each pipe shall be subjected to a hydrostatic proof test of 500 pounds per square inch. Each pipe shall be under the test pressure for at least five seconds. In addition to the hydrostatic test, each pipe barrel and each mechanical joint type socket shall be subjected to an air test. The test of the barrel and socket may be made simultaneously or separately at the manufacturer's option. Twenty-four inch and smaller pipe shall be tested under a minimum of 50 pounds per square inch air pressure, and 30" and larger under a minimum of 25 pounds per square inch air pressure. Each pipe shall be under the air test pressure sufficiently long for careful inspection for leakage. Air test shall be made with the pipe immersed in water or covered with a soapy water solution, and all tests shall be made before the application of any coating or lining. Any pipe that leaks in the barrel or socket shall be rejected.

Section 6—Gaging

The inside diameters of the sockets and the outside diameters of the spigots of mechanical joint type pipe shall be tested with circular gages. The outside diameter and the thickness of the barrels shall be checked periodically to insure compliance with the applicable specifications.

Section 7—Marking of Pipe

In addition to standard marking requirements, each pipe shall have the identification "American Ductile Iron", conspicuously painted on the pipe barrel, and the initials "AD" cast or stenciled on the outside surface.

Section 8—Test of Physical Properties

In addition to the applicable tests required by the specifications listed in Section 1, minimum tensile test requirements shall be as specified elsewhere for the various grades of American Ductile Iron, tensile tests being made in accordance with ASTM Specification A 339-55, Standard .505" diameter tensile specimens shall be machined from coupons cast from each heat, and shall have the same hardness range as the pipe.

Section 9—Acceptance Tests

The physical tests specified in Section 8 shall be used to determine the acceptability of the pipe. If written transcripts of test results are required, a request specifying the tests of which transcripts are desired shall accompany the order.

9

From American's catalog, this "spec sheet" gives basic information for gas utility customers.

Fig. 1. Night foreman G. W. Gardner and staff engineer W. R. Cannon, designer of the truck, discuss its merits.

Truck design speeds meter handling

By H. CROSBY, JR., Staff Supervisor
and W. R. CANNON, Staff Engineer
Washington (D.C.) Gas Light Co.

CHARGED with the responsibility for shuttling meters between the central meter shop and operating sub-stations, the service department of Washington Gas Light Co. has come up with a unique truck design which is a real time-saver. Using specially designed meter pallets, the truck can be loaded quickly by fork-lift, yet is low enough for individual meters to be removed easily by a man standing on the ground (*Figs. 1 and 2*).

All 250 service vehicles are equipped to carry from 8 to 14 meters. To avoid congestion and lost time resulting when each serviceman loads his own meters, all vehicles are loaded between midnight and 8 a.m. according to their posted schedules. A small reserve stock of meters at each sub-station allows for last-minute assignment changes.

Each serviceman removes "incoming" meters from his vehicle at the end of his shift and places them at a designated collection point. At night, the "meter loaders" take a truckload of meters from the central meter shop to each of the three sub-stations, check and replenish meters on all vehicles as well as the reserve stock, and return the "incoming" meters to the shop.

Meters are segregated by territory as well as by size. With three jurisdictions (District of Columbia, Maryland and Virginia) and four sizes (5B, 5M and 10M tin and 250 aluminum), a total of 12 different categories of meters must be handled from separate pallets each night.

Some vehicles, working in borderline areas, must

Fig. 2 (above). Meters of convenient height are easily removed to be loaded into service vehicles parked nearby. Fig. 3 (below). Meter removed from truck is placed in service coupe. Note coded loading schedule on trunk lid.

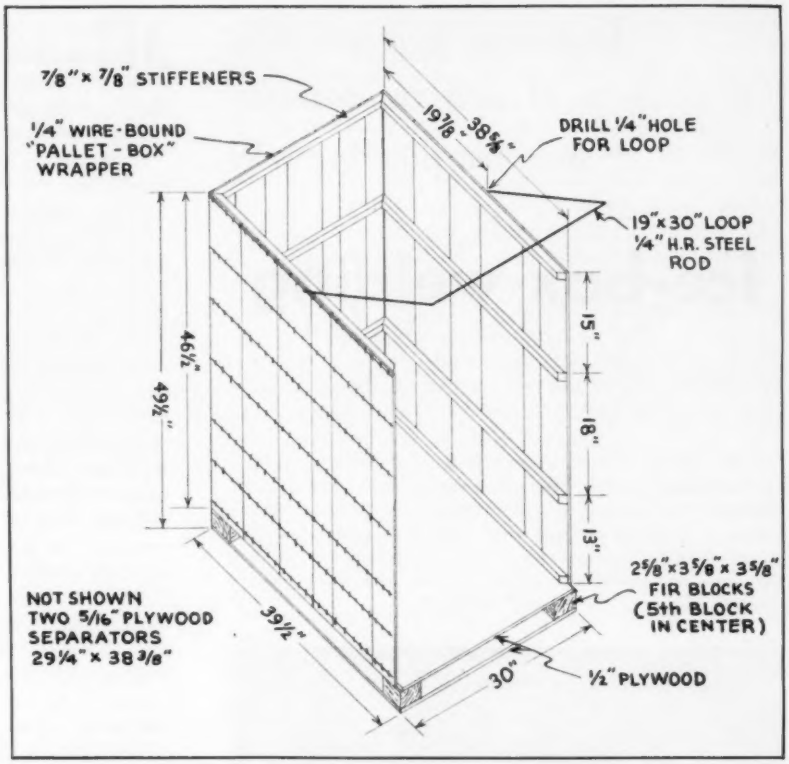

7/8" x 7/8" STIFFENERS
1/4" WIRE-BOUND "PALLET-BOX" WRAPPER
19 1/8"-38 5/8"
DRILL 1/4" HOLE FOR LOOP
19" x 30" LOOP 1/4" H.R. STEEL ROD
46 1/2"
49 1/2"
15"
18"
13"
2 5/8" x 3 5/8" x 3 5/8" FIR BLOCKS (5th BLOCK IN CENTER)
NOT SHOWN TWO 5/16" PLYWOOD SEPARATORS 29 1/4" x 38 3/8"
39 1/2"
30"
1/2" PLYWOOD

Fig. 4. Meter pallet designed by Washington Gas Light. Its capacity: 27 5-Lt tin meters; 27 250-aluminum meters; and 18 10-Lt tin meters.

carry several sizes of meters for two different territories. To simplify the loading job, a loading schedule is posted in the rear of each vehicle to show at a glance the sizes, territories and placement of meters in that particular vehicle (*Fig. 3*).

The specially designed pallet, costing approximately $15, is the heart of the bulk meter handling and storage. It is essentially a 30-in. x 39½-in. double-sized pallet base with a three-sided "wrapper" nailed to it. The wrapper is of wire-bound "pallet-box" construction, 46½-in. high around two sides and the back. The ends of the wrapper are 1⅛-in. short of the base to allow one empty pallet to be inverted on another for compact storage within the 30-in. x 39½-in. base area. Two removable 5/16-in. plywood separators are used between layers of meters, and at the top a loop of ¼-in. round steel rod pivoted at the center of each side reinforces the open edges of the wrapper and secures the top layer of meters when loaded (*Fig. 4*).

Each pallet holds 27 5-Lt. tin meters or the same number of 250 aluminum meters stacked 3 x 3 x 3 high. Ten Lt. tin meters are stacked 2 x 3 x 3 high, or 18 meters per pallet.

In the shop, meters are placed in pallets by size and by territory and fork-lifted to the designated line of gravity-feed, double tier storage racks. At night the fork-lift is used to remove pallets from the opposite end of the storage racks (providing first in-first out usage) and to load the meter truck.

The new truck, looking somewhat like an underslung soft-drink truck, was designed around the pallets. The low deck-height was made possible by use of Rid-Frame construction in which the truck frame is removed and the welded steel body itself acts as the chassis. The central "A" frame straddles the original rear spring assembly, gives rigidity to the body and provides a 5 deg inward tilt to hold pallets in the compartments. Safety chains were added as an extra precaution.

Eight pallet-sized compartments give a capacity of 216 5 Lt. meters. The decks with hinged mesh gates over the rear wheels on each side provide space for house regulators and larger size meters. By loading this space with four additional pallets, 324 meters can be carried. Locked compartments at the front are used by the meter loaders to store boots, rain-gear, gloves, flashlights, etc.

Starting with a conventional 16,000-lb GVW chassis with cab, the cost of the body, including cutting and removing the original frame, approximates $1800.

Before the new truck was put into operation, the men assigned as meter loaders were given special driver training to assure safe operation of the truck both on the road and in cramped quarters among the vehicles parked in the yard.

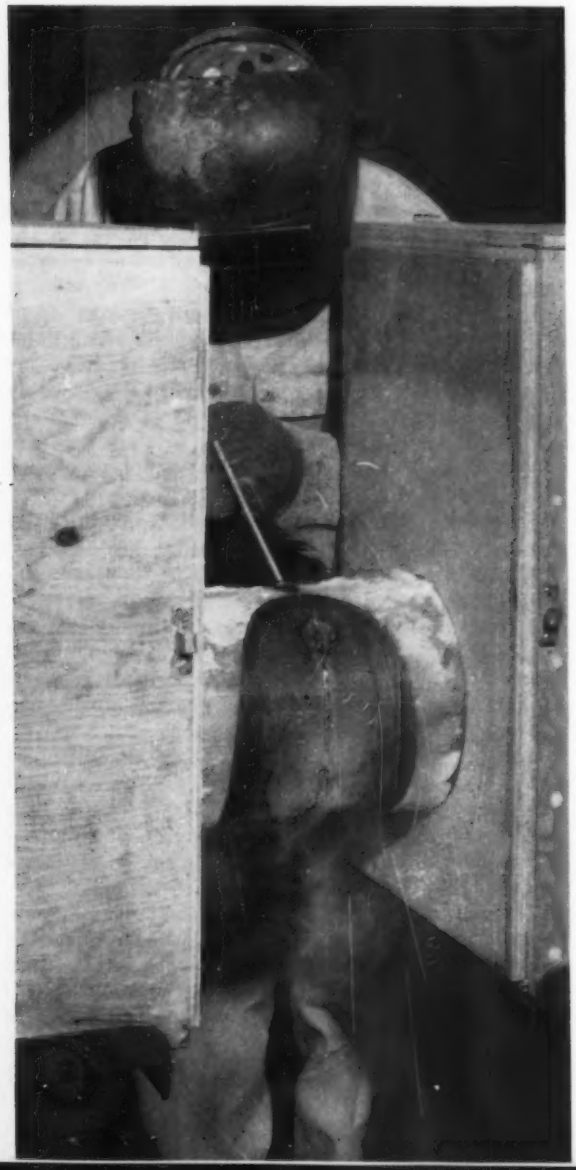
Meter loading production has more than doubled since the new truck, pallets and vehicle loading schedules were put into use. At present two meter loaders can cover all three sub-stations, replenish stock on 250 vehicles, check reserve stocks and return palletized "incoming" meters to the shop in 7½ hours.

The new truck was used to good advantage on periodic meter changes. A foreman with a crew of 12 men working from the truck changed about 4700 meters at an average net cost reduction of $2.10 per meter change—a saving of approximately $10,000. ■

Dramatic demonstration of new weld-in-any weather pipeline steel

Ice-box welding

Here's dramatic proof—Before a group of more than 100 top management men from over 20 companies, this welder joins two pieces of 55,000-psi minimum yield strength pipe that had been cooled down to 52 deg below zero. Note heavy frost on pipe, dark area where heat has melted the frost, and heavy frost on one side of one of the dry-ice-filled boxes.



MORE than 100 top management and technical representatives from over a score of gas transmission and producing companies witnessed a late-March demonstration of an apparent major breakthrough in line pipe steel—GLX-W.

Produced by Great Lake Steel division of National Steel Corp. the new high strength steel can be welded without preheating or controlled cooling and in below zero temperatures with ordinary welding rods. Furthermore, its weldability under ordinary field or manufacturing conditions is said to be better than other high strength steels.

GLX-W has roughly the same basic chemistry as mild carbon steels—with one difference, a small amount of columbium. While it is slightly more expensive on a per-ton basis than conventional carbon manganese steel of similar strength, initial experience has shown that GLX-W can be used in reduced wall thicknesses, meaning reduced initial costs, plus reduced freight and handling costs. This results in considerable savings which can be increased by lower welding costs.

That dramatic demonstration of the weld-in-any-weather qualities of GLX-W took place in Baton Rouge at Cal-Metal Pipe Corp., the nation's second largest independent pipe producer. (National Steel and Great Lakes Steel—unlike most major steel producers—do not make pipe.)

During the demonstration, short sections of pipe were welded together while in a 52-deg-below-zero ice box. The sections to be welded were placed in dry-ice-packed plywood boxes with just enough pipe sticking out to enable the welder to join them. The feat was performed with both 8-in. and 24-in. pipe. As clearly shown in the accompanying photos, this ice-box treatment heavily coated the pipe with frost. Yet, the weld was easily made, and with an ordinary welding rod as opposed to the special, costly rods which must be used for cold weather welding of carbon-manganese high-strength steels.

Under the watchful eye of veteran pipeliners, these sub-zero welds were then subjected to two tests. The first was magnafluxing. In the second, 24-in. pipe with a minimum tensile yield strength of 55,000 psi was tested out to 62,500 psi. The weld proved to be stronger than the surrounding material, indicating its high quality despite the conditions under which it was made.

A second demonstration also was of great interest. A length of 24-in., 55,000-psi yield strength GLX-W pipe was bent an amazing 20 deg. Although it it wrinkled slightly, there were no signs of collapse.

How about field testing? The first field installation of GLX-W pipe into a natural gas transmission line was completed last September by the Houston Contracting Co., one of the nation's major pipeline contractors. The 5-mile line was built for Houston Pipeline Co., subsidiary of Houston Natural Gas Co. It has been operating at 700 to 900 psig pressures without incident, even though it was subjected to extreme bending. (Portions were laid through a maze of existing lines in and near Beaumont, Texas.)

Cal-Metal Pipe and Houston Natural Gas decided that this pioneering installation should be made under the most revealing conditions. Accordingly, Houston

Contracting was permitted to assume that it was working with conventional high strength steel pipe instead of the 45,000-psi minimum yield strength GLX-W pipe it actually used.

Here's the reaction of H. J. Muckley, vice president of Houston Contracting:

"The (GLX-W) pipe had much better weldability than a 46,000 psi carbon-manganese grade. There was much less checking and cracking. It worked like softer pipe. We didn't have the welding problems that usually come with hardness. I would guess that this kind of pipe might make for a 10 to 15 per cent saving per mile in welding costs, as compared with equal strength pipe made from the steels now in general use."

Since 40-ft lengths were used on this job, about 135 welds were required per mile. Using carbon-manganese steel pipe, each weld costs $16 to $18. Therefore, 10 to 15 per cent savings should mean—under normal installation conditions—a saving of from $216 to $324 per mile.

"If this new steel means pipe is weldable in cold weather and without preheating and controlled cooling," Muckley continued, "it will reduce man power and equipment requirements and the number of defective welds. And, cold weather welding savings could amount to an additional $500 per mile."

For this installation Cal-Metal Pipe made GLX-45W steel into a 24-in. OD pipe with a 0.312-in. wall thickness. After being rolled, its yield strength exceeded the 46,000-lb minimum that had to be guaranteed to Houston Pipeline.

Because weldability and formability are the two basic variables in which production economies can be effected, they are as important to the pipe producer as to the pipe user.

"In weldability and formability," said Cal-Metal Sales Vice President K. S. Bayless, "We found GLX-45W to be equal to or better than other high strength steels having the same carbon and manganese contents. This was a significant experience, because conventional steels with the same contents offer substantially lower yield strengths. GLX-W steel was easier to weld, even automatically, than conventional steels of the same strenth."

Cal-Metal used an electric fusion welding process, which means metal is added. This is a standard process, all line pipe over 22-in. OD being either fusion welded or seamless. Welding was under a granular flux, also standard for large pipe.

AC and DC arcs were used in tandem, one following immediately behind the other. The first weld was put down from the outside, about two-thirds of the way into the plate. The second was laid from the inside to overlap the first, tying the two together.

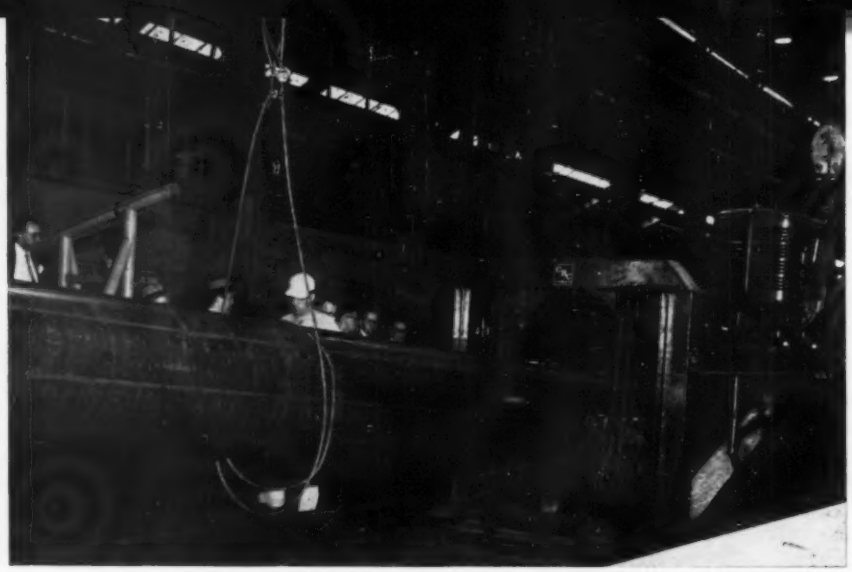
Rigid factory inspection revealed no traces of fissures or cracks in the welds. A slight tendency to undercutting was noted in both weld passes. However, no traces of crack propagation were found, even at the base of such undercuts. Examination for hardness revealed slight increases in the welds above the original plate and lesser increases in the heat-affected zones of the parent metal. This indicated greater ductility than is found in the heat-affected zones of conventional high strength steels, a highly desirable factor for natural gas transmission lines.

"We performed substantially fewer repairs and rewelds, which our customers don't like," Bayless added. "Aside from the way repairs and rewelds contribute to higher production costs, it has been the pipeline industry's experience that chances of a repair weld failing in field operation are 12 to 15 times greater than for a weld done properly in the first place. The weldability of GLX-W steels should contribute to lower pipe fabrication costs and lower field installation costs. It should also enable engineers and designers to build higher standards of safety into pipeline construction. Based on our experience with GLX-45W steel, we are now ready to promote its use and the use of higher strength GLX-W grades into long, cross-country pipeline uses."

This promotion is already beginning to pay off, for several companies are reported to have decided to use GLX-W steels and save substantial sums. One major company, for example, expects to save $50,000, just by using GLX-W steel for compression-type couplings.

Typical of the savings possible with GLX-W is a 185-mile 24-in. OD natural gas transmission line from Kiowa county, Okla., to Mineola, Kan. Originally, the project engineers intended to use conventional carbon manganese steel pipe with a minimum yield strength of 52,000 psi. Since the line was to have 1000 psig working pressure, they settled on 0.312-in. wall thickness.

The sub-zero welded pipe is magnafluxed under the watchful eye of Great Lakes Steel President Wilford D. MacDonnell (right) and A. G. Barkow, research engineer for Natural Gas Pipeline Co. of America and one of the world's foremost authorities on natural gas transmission pipe steels.



In another part of the demonstration, the 24-in., 55,000-psi minimum yield strength pipe was bent an amazing 20 deg without showing any signs of collapse.

However, with GLX-55W, they figured the wall thickness could be reduced to 0.297 in., a 5 per cent saving in steel tonnage. Corresponding savings would be made in initial purchase, freight, field welding, and handling costs. In addition, there is an added safety factor. After being rolled, the pipe has a 60,000 psi guaranteed minimum yield strength.

By going to an even higher strength of GLX-W, the reduction in wall thickness could be increased to 10 or 15 per cent, meaning corresponding savings all the way down the line.

Even a 5 per cent reduction, however, saves nearly one-half-million dollars on a project of this size. One mile of 24-in. pipe requires 331 tons of steel. Therefore, a 5 per cent reduction for a 185-mile project nets a saving of more than 2000 tons. At about $200 per ton of fabricated pipe, that amounts to a saving of $400,000. Freight costs average 10 to 14 per cent of the cost of the pipe, or $20 to $28 per ton. Thus, freight savings are $40,000 to $60,000. These two items alone mean a saving of $440,000 to $460,000. Add on handling cost reductions and other savings, and the total is one-half million dollars or more.

Where has this money-saving steel been hiding? National Steel, the nation's fifth largest steel maker, is the first to admit that columbium-treated steels are not new. The significance of GLX is that it marks the first successful use of columbium in a competitively priced steel. GLX is a semi-killed steel, which costs less to produce than the killed steels to which columbium development had been previously restricted. (Killing is a development-arresting procedure during the production of steel.)

Until recently, experimentation with columbium-treated steels has been discouraged by high columbium prices. Cost of the steel-gray, lustrous metallic element has dropped sharply in the last decade, however. Recent discovery of large deposits in Quebec have further aided the cause.

GLX-W steels may be defined as a family of high strength, fine grained, semi-killed mild carbon steels. Their chemical composition is approximately the same as for mild carbon steels in the 30,000 to 40,000 psi minimum yield strength range. Controlled addition of columbium raises their minimum yield strengths by 15,000 to 20,000 psi. A typical analysis of GLX-W steel is: carbon, 0.16 per cent; sulfur, 0.018 per cent; silicon, 0.05 per cent; manganese, 0.75 per cent, phosphorous, 0.009 per cent; and columbium, 0.01 to 0.04 per cent. The GLX-W family currently has four members with minimum yield strengths of 45,000 psi, 50,000 psi, 55,000 psi, and 60,000 psi.

Wilfred D. MacDonnell, president of Great Lakes Steel, forecasts that over the next two years the benefits of GLX-W steels will cultivate a demand throughout the pipeline industry for columbium-treated steels. However, he emphasizes that his company will not corner the market.

"Our plans for marketing these new high strength pipe steels are not tied to any ambition for becoming over-night a major supplier to this huge field of steel consumption. Nor do we have any definite short or long range plans for becoming an integrated producer of steel line pipe. Our own ability at Great Lakes Steel to supply these steels will—for the foreseeable future — preclude realization of those objectives."

Thus, it appears that one of the problems of the industry may be on its way to solution. The industry has been demanding higher and higher strength steels for higher and higher pipeline working pressures. The solution has always been a higher carbon-manganese content, but ever-increasing welding problems have brought about the realization that 56,000 psi minimum yield strength carbon-manganese steel may be about the end of the road in that direction. Recently, Great Lakes Steel made available a 60,000 psi grade, but few if any orders have been placed for it.

GLX-W steels, therefore, seem to have come along at just the right time. While several dollars per ton more expensive than comparable carbon-manganese steel, this added cost can be more than offset in just the savings stemming from the elimination of preheating and cooling. Clearly, then, columbium steels may have a great future in gas transmission. ■

GAS DISTRIBUTION NEWS

100% increase seen for Sixties, but industry must work harder

DURING the Sixties, distribution and pipeline companies will increase construction outlays 100 per cent to increase the nation's gas network 50 per cent. That prediction was made by AGA President Wister H. Ligon as he opened the group's 1960 distribution and transmission conference May 9 in New Orleans.

At the same time, Ligon injected a note of caution: "We would make a grave mistake if we regarded the Sixties as a period in which manna would fall for us to gather. The rich fruits of this decade will fall to those who shake the tree the hardest. And, if our competition shapes up as we expect it will in the next few years, we may even have to shinny up the tree to get the best pickings."

Ligon estimated distribution and pipeline companies will spend $28.3 billion for expansion in the Sixties, as opposed to $14.2 billion in the Fifties. He cited industry forecasts that the number of gas customers will increase 40 per cent in the next 10 years while gas sales will double.

"Since many of our gas systems already are operating at full—or close to full—capacity," he said, "we cannot and do not expect to deliver more gas to more customers without very substantial additions to our facilities. We estimate we will have to add more than one-quarter million miles to our gas network (pipelines, mains, and transmission and distribution field and gathering lines), increasing it from 596,000 to 878,000 miles."

Utilities want share of Peoples' new storage

Two kinds of opposition met a late-April petition by Peoples Gas Light & Coke Co. (Chicago) to test and develop an underground storage facility 125 miles south of the Windy City. Simultaneous petitions with the Illinois Commerce Commission asked that two other distribution companies, Northern Illinois Gas Co. (Bellwood) and North Shore Gas Co. (Waukegan), be allowed to share in the project. At the same time, the farmers and landowners involved asked for higher easement right fees than had been offered.

The project, near Champaign, belongs to Union Hill Gas Storage Co., a Peoples' subsidiary which explores and develops underground storage facilities. Peoples plans to buy the project, develop it through the pilot stage, then seek approval to construct and use it.

SoCounties moves into new headquarters

Southern Counties Gas Co. moved "next door" to its new contemporary home in early May. The 13-story downtown Los Angeles structure was officially dedicated when SoCounties President Guy W. Wadsworth, Jr., lit the decorative gas light that will glow permanently at the building's main entrance. The company's new home is adjacent to—and attached to—its former home, which it jointly shared with its sister company, Southern California Gas Co.

Designed and engineered by the architectural firm of Albert C. Martin & Associates, the 115,000-sq ft building is a steel frame and lightweight concrete structure. Seismic forces are taken in columns supported on spread footings, permitting a completely open ground floor—ideal for display.

The exterior presents a contemporary face to the heaviest stream of traffic in the world, Los Angeles' Harbor Freeway. Clearly visible to freeway traffic is a 48-ft high luminous flame perched atop the contemporary structure. Exterior surfaces include: blue, black and white porcelain enamel curtainwall panels; gray solar glass; satin aluminum; ceramic veneer; and granite.

The new building also provides executive offices for Pacific Lighting Corp. and Pacific Lighting Gas Supply Co.

Arizona PSCo. buys its 2nd large computer

Three times more effective in solving engineering problems: that's the performance goal Arizona Public Service Co. set in announcing its second large electronic computer, to be installed late this year.

When the Phoenix-based utility bought its first large computer four years ago, "it was thought the new machine would have sufficient capacity for quite a number of years," says Computer Services Manager Walter Levi. "But, due to the state's tremendous growth—and therefore our growth — the original Univac is working at top capacity 24 hours, six days a week."

The new Univac, a "Solid State 80," costs $500,000 but is expected to pay for itself in three years. It will have a memory of 5000 words, five times that of the present computer. Accordingly, it will be able to solve more complex engineering problems, meeting nearly 75 per cent of the company's engineer needs, compared to the present system's 25 per cent capabilities.

Physical size is reduced from the old vacuum tube unit, meaning that both units can occupy the quarters originally designed for one unit.

Computer streamlines operations

BROOKLYN Union Gas Co.'s accounting procedures are due for streamlining. The company has ordered a transistorized IBM 7070 electronic computer.

One of its major jobs will be processing meter readings into completed bills and make up-to-the-minute statistics available to management. The electronic brain can add 16,000 five-digit figures in a second.

The 7070 will be installed in BU's new 14-story general office building when it is opened late next year. Working with the computer will be four transistorized IBM 1401 systems. They will print documents at high speed from magnetic tapes prepared by the 7070.

Meter readings are shown on IBM cards by a few simple strokes with a special pencil. Then they will be translated automatically into machine codes. The 7070 will use the cards to update customer records on magnetic tape, prepare monthly bills, and compile management reports.

Also stored on magnetic tape will be a complete accounting of the 20,000 items—from gas jets to 36-in. pipeline—BU needs to keep its field operation running smoothly.

The computer will signal when any of these is in low supply. Every item needed for gas service will always be available.

Additional assignments for the computer: payroll accounting for about 4000 employees, accounting for appliances sold by BU, and preparation of stockholder records.

Edwin J. Vetog, manager of Brooklyn Union's new centralized data processing department, heads the preparation for computer procedures.

Kansas-Nebraska honors gasmen

Kansas-Nebraska Natural Gas Co., Hastings, Neb., has cited three employees for outstanding accomplishments during 1959.

Division meterman Dorsey N. Arnold, Julesburg, Colo., received the public relations award. A plaque presented to him reads: "For your outstanding and noteworthy contributions toward the preservation of Kansas-Nebraska's reputation for integrity in business . . . for participation on community and civic affairs . . . for leadership and support in projects to promote progress and prosperity . . . and for being a good neighbor. . . . "

The 1959 efficiency award went to Charles S. Duncan, division manager at Albion, Neb., and Henry K. Wilken, superintendent of the Tyrone (Okla.) gasoline plant.

Their awards were for: " . . . consistent contributions toward the maintenance and improvement of Kansas-Nebraska service, the equipment for production, transmission and distribution of natural gas and the methods for conducting our business. . . . "

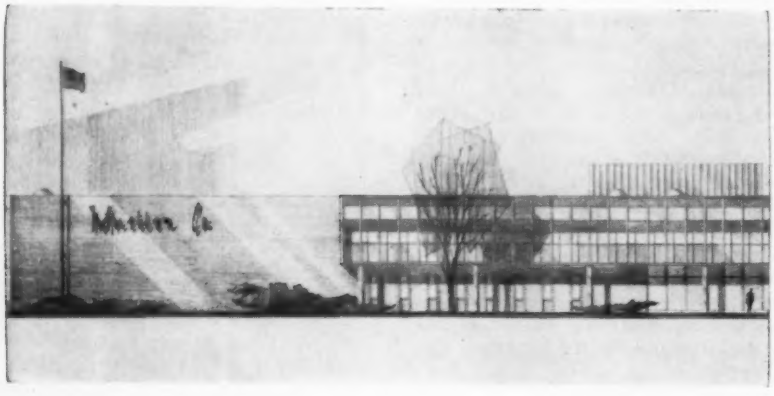
Each winner also received a $100 Savings Bond.

Barber-Greene plans Smith Engineering merger

Barber-Greene Co., Aurora, Ill., and Smith Engineering Works, Milwaukee, plan to merge. The merged companies will operate under the Barber-Greene Co. banner with its present officers, plus Gerald L. Smith and Donald D. Barnes as vice presidents and members of the board. Smith Engineering will operate as a division of Barber-Greene. Smith will become president and Barnes executive vice president of the Smith Engineering Works Division.

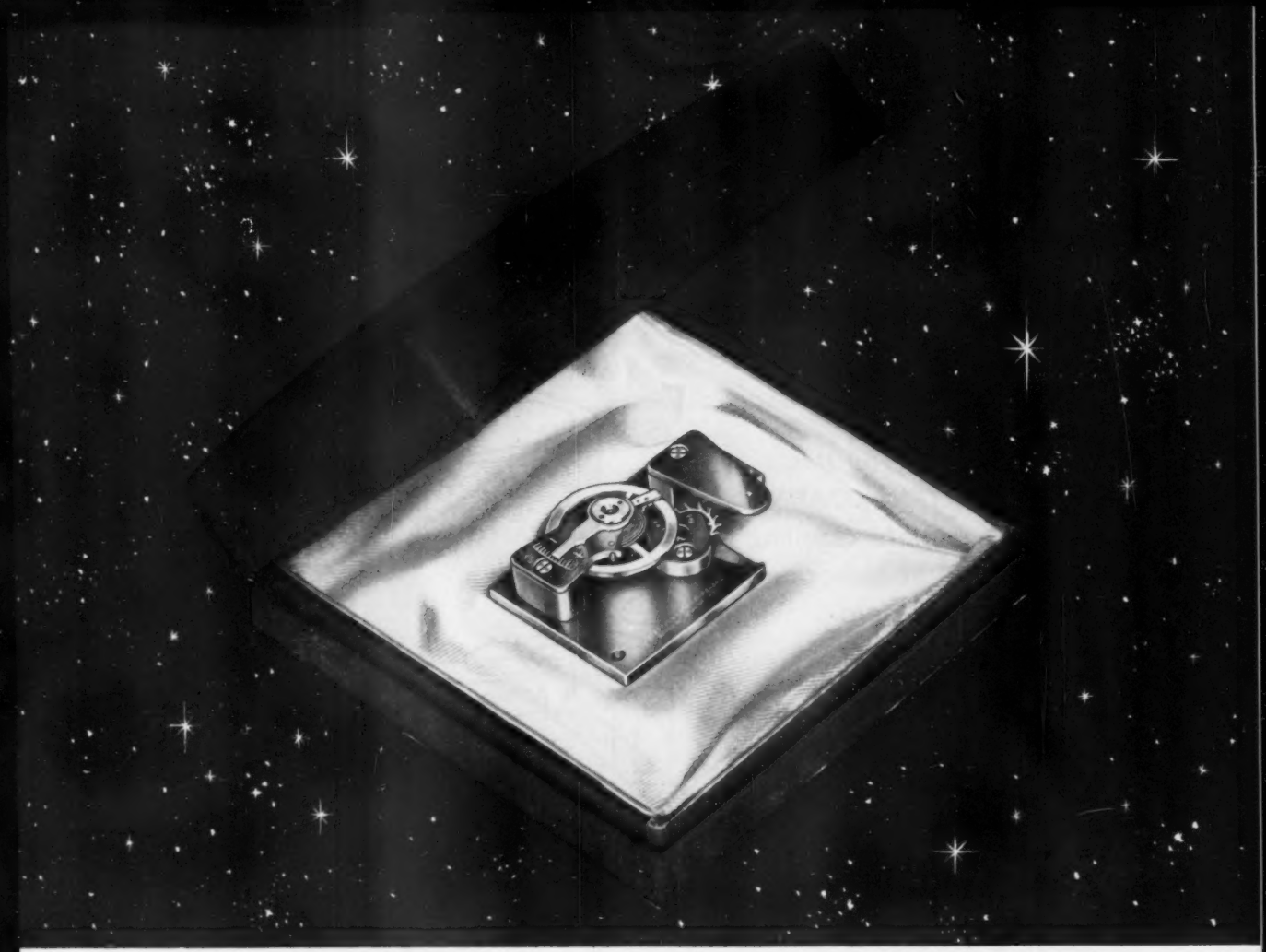
Top salesmen

Two of the top 10 salesmen in southern California were from the area's gas companies: Arthur E. Steed (2nd from left), Southern Counties Gas Co., and J. B. Twedt (2nd from right), Southern California Gas Co. Congratulating the pair are Burt Larson (left), SoCounties general sales manager, and Pat Shea, SoCal general sales manager. Steed and Twedt received the annual Sammy awards.



Modernization

A major modernization and expansion program has been launched by Mueller Co. at its main plant in Decatur, Ill. The $5 million program will replace more than half of the structures. The new buildings will be connected to existing facilities by a new underground pedestrian tunnel. Some 261,500 sq ft of floor space will be added and 43,300 sq ft of space will be rehabilitated. Included in the plan are an air-conditioned office building, a steel and brick manufacturing and warehouse building, and a two-story shipping and receiving building.



This "jeweled" escapement brings you fine watch quality in chart drives

See how easy it is to convert to seven different rotation rates

The main arbor on the basic chart drive has a rotation rate of seven days. Economical snap on turrets convert this rate to 8 day, 15 day, 16 day, 24 day, 30 day, 31 day and 24 hour rotation. No tools are required and you can even change chart rotation without removing the drive from the instrument.

Now, for the first time you get the extra value of a jeweled movement. This superior construction makes Rockwell chart drives more accurate and sensitive than ordinary chart drives. It requires less power to drive and is extremely durable since there are seven hard jeweled surfaces to overcome friction and wear.

You can use these jeweled movement chart drives *with profit* to power all your recording instruments. They will adapt into practically any instrument case. Speed changing turrets (see left) permit varying rotation rates at will. Write for bulletin. Rockwell Manufacturing Company, Dept. 60F, Pittsburgh 8, Pa. In Canada, Rockwell Manufacturing Company of Canada, Ltd., P.O. Box 420, Guelph, Ontario.

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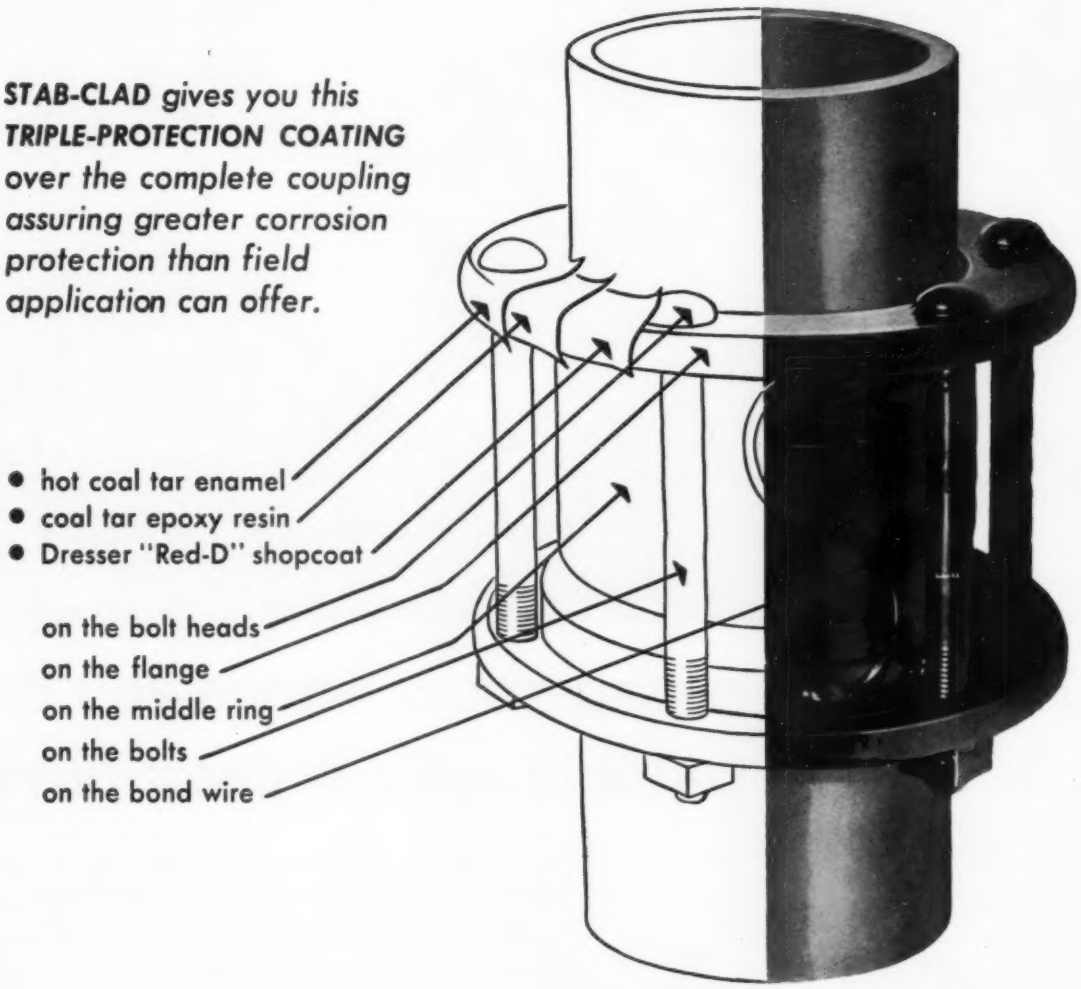
• hot coal tar enamel
• coal tar epoxy resin
• Dresser "Red-D" shopcoat
on the bolt heads
on the flange
on the middle ring
on the bolts
on the bond wire

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Washington State has Natural Gas Week

The full impact of natural gas upon the industries and people of the state of Washington was realized recently when the state celebrated Natural Gas Week. Washington's governor named the week in recognition of the growing importance of natural gas to the area.

Sponsors of the week were the Association of Washington Gas Utilities and El Paso Natural Gas Co., supplier of gas in the state. Members of the association are Cascade Natural Gas Corp., Columbia Gas Co., Northwest Natural Gas Co., Olympic Gas Co., Pacific Natural Gas Co., Washington Natural Gas Co., and Washington Water Power Co.

Ads placed in newspapers throughout the state were strongly supported with editorials and editorial matter carried by the newspapers in the area.

In addition, radio and TV saturation advertising, speeches by industry leaders at civic group luncheons and banquets, proclamations by mayors of local communities, were part of the overall program.

Gas company officials had a full calendar of appearances. They addressed chambers of commerce, Rotary, Kiwanis, and other organizations.

FPC chairman Jerome K. Kuykendall was principal speaker at the regular weekly luncheon of the Seattle Chamber of Commerce.

Revised utility control studied in New Mexico

New Mexico is studying a plan to return authority administered by the Public Service Commission to the State Corporation Commission. The PSC would be eliminated. Control over gas, electric, and water utilities was given to the PSC when it was created by statute in 1941.

Under the plan, proposed by SCC member John Block, SCC members would remain elective, rather than appointive. PSC members are appointed by the governor.

The SCC regulates the telephone, railroad, trucking, pipeline, aviation and insurance industries, charters corporations, and has other duties.

Gas vent institute moves

Offices of the Gas Vent Institute have relocated at 333 N. Michigan Ave., Chicago 1.

Kwik-Mix appoints

Star Machinery Co., Seattle, is a new distributor for Ka-Mo products from Kwik-Mix Co., Port Washington, Wis. Star's territory includes 26 counties in western Washington.

Parker names distributor

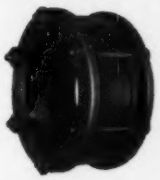
Alta Engineering Co., Salt Lake City, is a new distributor for Parker Seal Co., Culver City, Calif. Alta covers western Colorado, southern Wyoming and Idaho, eastern Nevada, and Utah.

Atlanta Gas builds

Construction is underway on Atlanta Gas Light Co.'s new building that will house operating and accounting departments. The new $1 million structure is in southeast Atlanta. Above the front entrance and extending to the top of the building will be a decorative masonry grille, composed of hundreds of flame-shaped designs.

DRESSER®
COUPLINGS

STYLE 38

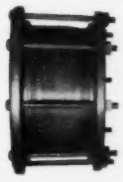


INSULATING
COUPLINGS

STYLE 39

REDUCING
COUPLINGS

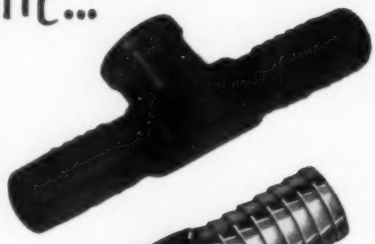
STYLE 62



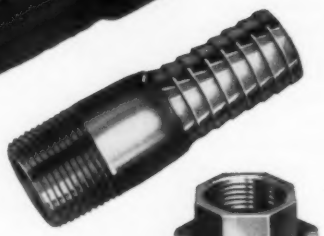
SOLVE YOUR
PIPE
CONNECTION
PROBLEMS

DRESSER
MANUFACTURING DIVISION
Bradford, Pennsylvania

"Shucks, if it's a full line you want...



SPECIFY U-BRAND FITTINGS." Why waste valuable time buying from different sources? When you stock and use U-Brand fittings you are assured a complete, top-quality line from one source. All fittings are conveniently packaged and marked for immediate use.



FOR ALL YOUR FITTING NEEDS: • Galvanized and Black U-Cote Malleable Fittings • Unions • Plugs and Bushings • Steel and Brass Nipples and Reducing Nipples • Steel and Brass Insert Fittings • Poly-Plus Blue and Nylon Plastic Insert Fittings • Dielectric Fittings • Sanitary Well Seals.

The Union Malleable Manufacturing Company

Ashland, Ohio · Vernon, Calif.

SOLD THROUGH WHOLESALERS ONLY

SHIPPING DEPOTS IN PRINCIPAL CITIES ASSURES OVERNIGHT SERVICE

Heating record

H. M. Ramsey (center), executive vice president of Philadelphia (Pa.) Electric Co. accepts gold-plated gas meter from American Meter president William G. Hamilton Jr. The presentation marks the utility's 100,000th gas home heating installation. J. Henry Long, vice president for gas operations, Philadelphia Electric, looks on during the ceremony.

Plans made for 20th measurement course

Initial plans for the 20th annual Appalachian Gas Measurement Short Course have been completed. The dates are Aug. 29-31, at West Virginia University in Morgantown.

Paul Riley

R. H. Lussky

The three-day course will cover fundamentals of gas measurement. Special sessions are slated on domestic, orifice, and large capacity meters; automatic control instruments, pressure regulators, and other related equipment.

R. H. Lussky of the Public Service Commission of West Virginia is general chairman of the short course. Paul Riley, Commonwealth Gas Corp., Richmond, Va., is the program chairman.

Additional information is available from Prof. R. E. Hanna, University of West Virginia, Morgantown, W. Va.

RIDGID®

535 Pipe & Bolt Threading Machine

Just 1 Universal Die Head and 2 Sets of Dies Threads ½" to 2"

Cuts Die Changing 66% — Two sets of dies do the work of six . . . adjust to size right in machine. One set for ½" and ¾"; the other for 1", 1¼", 1½" and 2". All other RIDGID quick-opening pipe and bolt die heads and dies can be used.

No Slow Back-Off — Quick flip of throw-out lever retracts dies instantly, after thread is cut.

Fast Chucking — RIDGID Speed Chuck grips tight, forward or reverse . . . sets and releases fast by hand. Tools swing out of way for chucking of short lengths from front.

Always True Threads — Cam-action rear-centering device gives extra support for long pipe lengths . . . no wobble.

Full-Floating Cutter — Roll-type cutter with large easy-to-turn handle has full-floating action for smooth cuts, even on out-of-round or bent pipe.

Smooth Reaming — Five heat-treated straight cutting flutes ream ⅛" to 2" pipe or conduit fast and smooth.

No Oil Waste — Self-contained oil system has vane-type pump that circulates oil when nozzle is positioned for threading.

Easy-to-Read Length Gauge — Sliding indicator gives accurate cut-off and thread lengths. Large lathe-type handle controls tool movement.

Plenty of Power — Fast, trouble-free universal-type ½ h. p. motor, reversible at switch, easily threads up to 12" pipe with geared tools.

See and Try the Time-Saving RIDGID 535 at Your Supply House!

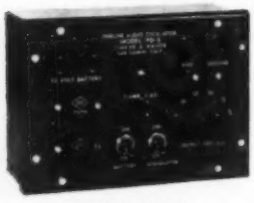
RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

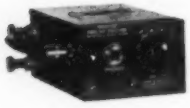
TR

DETECTOR

locates pipeline holidays and electrical contacts underground



OSCILLATOR



RECEIVER

Problems caused by underground pipe contacts with other lines and holidays in the protective coating can be solved by the Tinker and Rasor Pearson-type Detector which locates underground shorts in coated pipelines.

This completely transistorized unit finds trouble spots underground without the necessity of uncovering the pipe. Working in tandem, a two man crew can inspect an entire line, locating coating breaks, contacts with other lines and mapping the entire line.

The TR Underground Holiday Detector operates on a 12 volt automobile battery. It generates a 15 watt, 750 cycle, stable A.C. audio-frequency signal on a pipeline. Two 750 cycle resonate filters in the receiver reject unwanted signals.

Write today for technical data and bulletin.

TR **TINKER & RASOR**

417 Agostino Road, P.O. Box 281 • San Gabriel, California

Sayre: Hold on to gas range market

The dominant replacement market for ranges obviously belongs to the gas industry, says Judson Sayre. The chairman of the board of Norge was speaking before the Southern Gas Association's recent annual convention in Galveston.

Sayre's statement was based on a forecast that 70 per cent of all ranges sold in the Sixties will be the free-standing type.

"Of the total sales, range replacements increased from 53.3 per cent in 1954 to 64.7 per cent in 1959. But these are only percentages." Some 25 million households have obsolete gas ranges, "each one a prime target for replacement."

Sayre urged the gasmen to "hold the line at your present market position."

" . . . Gas ranges continue to be the lifeblood of your domestic business . . . the 'meat and potatoes' that give you the muscles and sinew to pursue, vigorously, the markets for other gas appliances. And, let's recognize that the gas range is no longer as unglamorous as it used to be. In fact, in styling and features, the top models parallel the very finest electric ranges . . . in performance, whether on top or in the oven, the controlled flame may never be matched by electric cooking, regardless of added gimmicks and pushbuttons."

" . . . Historically, and in the foreseeable future, the cooking range is, and will remain, the anchor appliance in the kitchen, and . . . the key to any future development of an all-gas kitchen. . . . I think we can further agree that, if this industry is to achieve its stated objectives, it dare not retreat much further from its present share of the market. . . . We might consider it axiomatic that if a 220 line is run into the kitchen for an electric range, the chances for a gas refrigerator sale become rather remote.

"This, I maintain, is the number one challenge. . . . You must, at the very least, hold the line on your present market position in range sales. If you lose this position now, grandiose plans for the future will only give you a nice warm feeling."

Name Parsons distributor

Pelican Machinery Co., Bossier City, La., has been named northern Louisiana distributor by the Parsons Co.

Marks long service

Fifty years of service to the gas industry, and Elizabethtown Consolidated Gas Co., were celebrated by Dennis J. Manning recently.

Manning, who started as a chauffeur with the Elizabethtown Gas Light Co. (as it was then known) and worked his way up to assistant superintendent of distribution, retires on July 1 as a consultant.

In those 50 years, Manning was a driving force behind many redesigns of mechanical tools and equipment to better serve the gas industry. His achievements in the field of gas engineering are evidenced by the many patents he holds on devices for improving distribution techniques.

His most recent invention is the ELF, a device for locating gas leaks electronically.

Washer-dryer rental program studied

Elizabethtown Gas Co. has launched what is believed to be the nation's first and only home laundry rental program. Test area is Westfield, N. J.

One hundred deluxe gas washer-dryers were made available for public rental. Area families can rent the units on a 12-month plan. All charges are included in one monthly rental fee. Delivery, installation, venting and service are free.

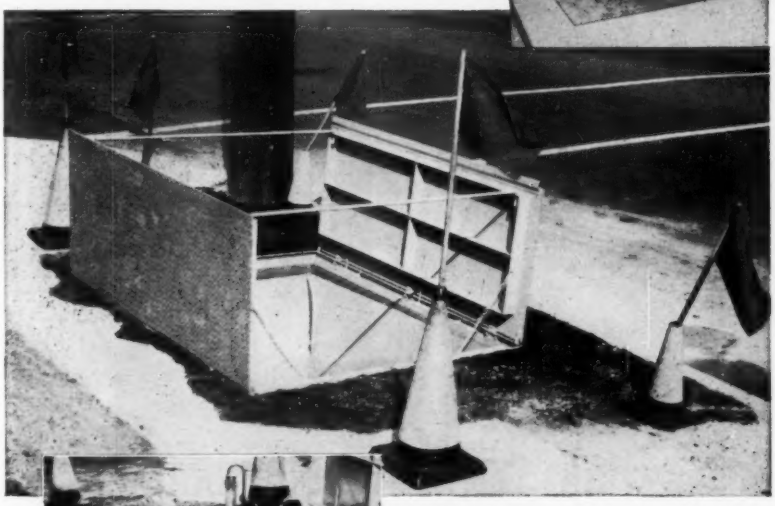
Working with Elizabethtown's vice president John Kean was Harold P. Bull, vice president of sales for Norge division of Borg-Warner. Public reaction to the test program will determine its extension to other utilities.

Field demonstrations slated for corrosion course

More than 500 students are expected to attend the fifth annual Appalachian underground corrosion short course, June 1-3, at West Virginia University, Morgantown, W. Va.

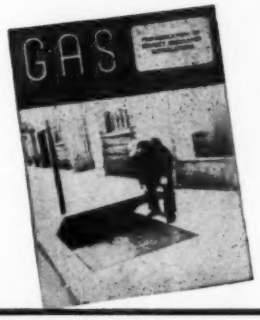
Highlight of the course will be 12 field demonstrations covering products and equipment. In addition to 54 classes, there will be educational movies on corrosion and 40 exhibits on corrosion materials and equipment.

easiest access to regulators under-the-sidewalk



SPRING-BALANCED BILCO DOORS ARE EASY-TO-OPEN AND COMPLETELY WEATHERTIGHT

Bilco vault doors are the safe choice for gas regulator vaults underfoot. More and more gas companies are finding that Bilco doors wear better, keep water out. When opened they provide maximum ventilation for service men's safety. Built-in drainage and easy maintenance add up to another Bilco bonus—and every Bilco door swings open easily because it's *spring-balanced!*



Send coupon today for FREE copy of article in Gas Magazine, entitled: "Standardization and Prefabrication of District Regulator Installations."

Bilco®

DOORS FOR SPECIAL SERVICES

The Bilco Company, Dept. A-196
New Haven 5, Conn.

Send reprint of article in Gas Magazine ( )
Send catalog with details of Bilco sidewalk doors ( )

Name_____
Firm_____
Address_____
City_____ Zone___ State_____

WHY SPEED-UP WEAR?

Lancaster

non-crack SYNTHETIC DIAPHRAGMS

improve gas meter accuracies without changing index gear ratios . . . without fabric failure

Gas meters operate at regular speed with Lancaster diaphragms S-7-L (and S-70-L with new adjustable height side carrier and oval-slot center bracket) for 1-A, #240 and Beta gas meters!

You increase meter accuracy without increasing meter wear. There's no cloth lining to cause fabric failure . . . no need to change standard meter parts . . . no need to hurry up meter wear.

Actual service and laboratory tests have proved the high flexibility low differential and superior performance. Order Lancaster Synthetic Diaphragms.

Lancaster

METER PARTS CO.

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Catalog No.	Sprague
S-70-L	1-A
S-70-L-240	240
S-7-L	1-A
S-7-L-240	240

Other Lancaster Synthetic Diaphragms

C-1-L	#1 Ironclad
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1-L	#1 Emco

See catalog for complete line of leather diaphragms

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5300 gas dryers

Pointing at one of the ads used in the recent Arkansas Louisiana Gas Co. gas dryer sales campaign are W. R. Stephens (left), president and board chairman of ALG, and Harold P. Bull, vice president in charge of sales for Norge division. An 8-week campaign resulted in the sale of over 5300 dryers.

PG&E's gas storage field operating

Pacific Gas & Electric Co.'s new gas storage field near Winters, Calif., is in operation.

Initial working capacity of the field is 1.2 billion cu ft. Ultimately it will be 3.25 billion cu ft. Withdrawal rates up to 80 MMcfd are planned.

This is PG&E's first storage field. A second, near Stockton, is under development.

Saskatchewan signs for Alberta gas supply

Saskatchewan's current and future gas needs will be met with natural gas from Alberta.

Saskatchewan Power Corp.'s Alberta subsidiary signed the contract for gas from the Many Islands field.

Involved is an estimated reserve of 700 billion cu ft of gas in place.

Hill, Hubbell division sold

National Malleable & Steel Castings Co., Cleveland, has bought General Pacific Corp.'s Hill, Hubbell Division. Headquartered in Cleveland, Ohio, Hill, Hubbell has plants in Youngstown and Lorain, Ohio; Hammond, Ind.; Denver, Colo.; and Napa, Calif.

GAS ASSOCIATIONS

Canadians heading for Quebec

More than 500 delegates are expected at the Manoir Richeleau in Murray Bay, Quebec, on June 22-25 for the Canadian Gas Association annual meeting.

N. E. Tanner, president of the association, will preside over the program.

Williams heads NEGA

Gilbert J. Williams, executive vice president and director of Connecticut Light & Power Co., is the new president of the New England Gas Association. He succeeds George R. Copeland, president of Algonquin Gas Transmission Co.

Other new officers: 1st vice president, Harold L. Dalbeck, president, Gas Division, New England Electric System; 2nd vice president, John F. Rich, president, New England Gas & Electric Association; treasurer, Burdette A. Johnson, treasurer, NEGEA.

Mid-West names Mayer

J. S. Mayer of Northern States Power Co. was elected president of the Mid-West Gas Association at the group's recent convention.

Serving with Mayer are C. J. Math, Iowa-Illinois Gas & Electric Co., 1st vice president, and K. W. Person, Minneapolis Gas Co., 2nd vice president.

Everett E. Baxter, long-time secretary-treasurer, was succeeded by J. J. Finnegan of Northern Natural Gas Co.

Wilson heads SGA

Southern Gas Association's new president is James A. Wilson, a vice president of the Texas distribution division of United Gas Corp. He succeeds Oliver W. Clark, Southern Natural Gas Co.

Other officers elected: H. A. Eddins, 1st vice president; C. L. Nairne, 2nd vice president; Willard G. Wiegel, re-elected treasurer; and Frank Barragan Jr., re-elected secretary.

There are more DAVEY "Auto-Airs" in service today than the combined total of all competitive makes!

Here are a few of the many reasons for this overwhelming preference

The Davey Hydrovane Rotary "Auto-Air", driven direct from the truck engine through a Davey heavy-duty power take-off, is the world's most portable compressor. It moves from job-to-job as fast as the truck will travel.

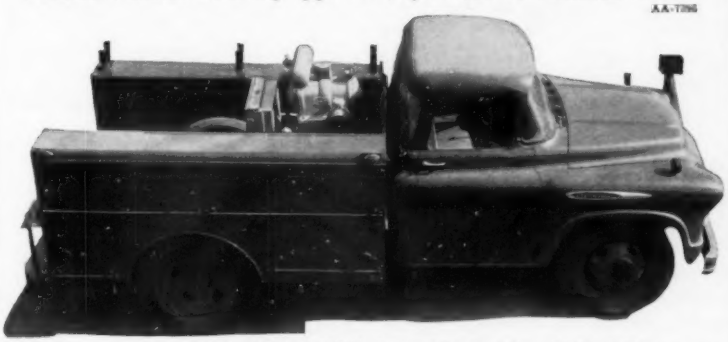
Price of complete compressor-truck unit compares favorably with trailers of same capacity.

"Auto-Air" occupies only one-third of truck body space. Rest is available for transportation of men, tools, materials.

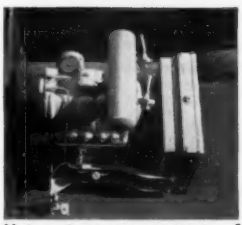
Davey is the only manufacturer that builds the complete "Auto-Air" . . . covers compressor and take-off with one guarantee.

Standard "Auto-Airs" are available in 125 and 160 c.f.m. capacities . . . other sizes on special order. They can be mounted on most standard trucks with any type of body. Write for Bulletin E-230.

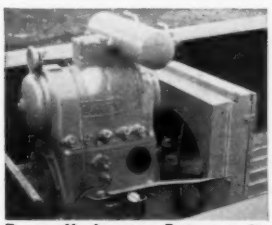
AA-7286



Typical Model 125 Hydrovane Rotary "Auto-Air" installation.



Note extreme compactness of Hydrovane Rotary Compressor.

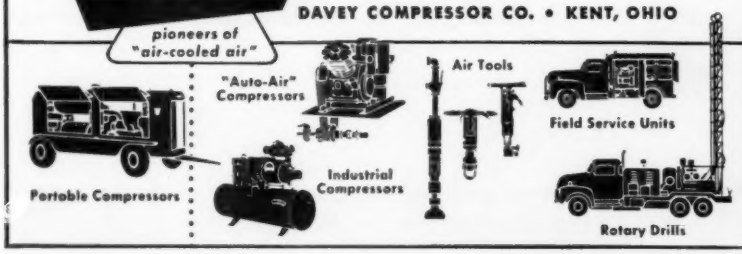


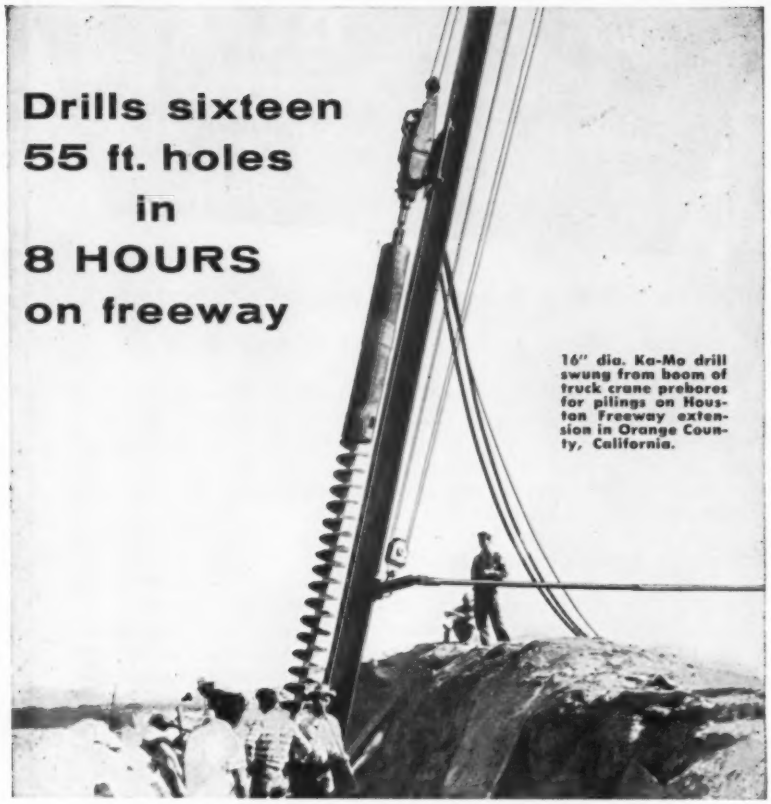
Davey Hydrovane Rotary units have 50% fewer working parts than ordinary compressors . . . are easy and economical to operate, maintain, service.

DAVEY

pioneers of "air-cooled air"

DAVEY COMPRESSOR CO. • KENT, OHIO





16" dia. Ka-Mo drill swung from boom of truck crane prebores for pilings on Houston Freeway extension in Orange County, California.

Ka-Mo 16" drill sets record pace preboring for pilings on Houston Freeway

Bertran Drilling Co., contracted to prebore holes for cast-in-drilled hole concrete pilings on construction of Houston Freeway extension in Orange County, Calif. Job called for drilling a series of vertical and battered holes — 16" in dia. — with various depths to 72 ft. To handle work, Bertran brought in a Ka-Mo vertical drill, powered by a 34 h.p. self-contained hydraulic motor. Swung from boom of 25-ton truck crane, the 16" dia. drill bored as many as 16 holes — 55' deep — in 8 hours! At several places on job — same drill also bored eight 72-ft. holes in one 8 hr. shift. Record production — 2 to 1 over any other machine owner is familiar with — was obtained by using continuous sectionalized drill flights.

10 to 15% saving in concrete

Vic Zonver, owner of Bertran Drilling reported an unexpected saving in amount of concrete used to pour pilings bored by Ka-Mo drill. Normally, by preboring with conventional systems, hole needs 10 to 15% more concrete than estimated theoretical volume. Drilled holes by Ka-Mo continuous-auger system required only about 1% more concrete.

Pays to check

Whether your work involves angular, vertical, or horizontal drilling, it will pay you to check the Ka-Mo line. Drill sizes 2" to 48" diameter, and larger — sectionalized lengths — air, hydraulic, electric, gasoline, or diesel powered. Engineering service is always available for these special installations. Just write or call.

Mail to: KWIK-MIX CO., Ka-Mo Tools Dept., Port Washington, Wis.

☐ Send us free booklet on Ka-Mo drilling method.

NAME ..... TITLE .....

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STREET .....

CITY ..... STATE .....

KAM-8 GAS

KA MO **KWIK-MIX COMPANY** — Ka-Mo Tools Dept.
A DIVISION OF KOEHRING COMPANY

GAS • PEOPLE

Dan E. Karn
Consumers

A. H. Aymond Jr.
Consumers

DAN E. KARN has retired as president of Consumers Power Co., Jackson, Mich. New officers include ALPHONSE H. AYMOND JR., chairman of the board and chief executive officer. Until now, Aymond was executive vice president. JAMES H. CAMPBELL, senior vice president, becomes president and chief operating officer. Karn will stay with Consumers as a consultant and will become chairman of the finance and budget control committee.

STEPHEN H. BAER heads personnel functions of Pacific Lighting Gas Supply Co. in addition to his public relations duties. Baer, whose title is public relations and employee relations director, joined the Los Angeles company in 1958. From 1954 to 1958, he was on the news-publications staff of affiliated Southern Counties Gas Co.

There have been several promotions in Northern Indiana Public Service Co.'s new northeastern division. JAMES D. BREED becomes manager of the combination (gas and electric) Goshen district. JACK W. STINE, NIPSCO manager in Columbia, succeeds Breed as manager of the all-gas Elkhart district. PAUL E. SEYBERT is manager of the South Bend district.

J. H. Campbell
Consumers

Stephen Baer
PLGS

Southern Cross Foresters, Atlanta, has named MAYES PIERCE to the post of operations manager. Pierce, with Southern Cross since 1950, most recently served as assistant to the president, James Chaisson. The company has named WILLIAM T. BARNETT JR. regional representative, headquartered in Dallas. Barnett will handle sales activities in the Southwest.

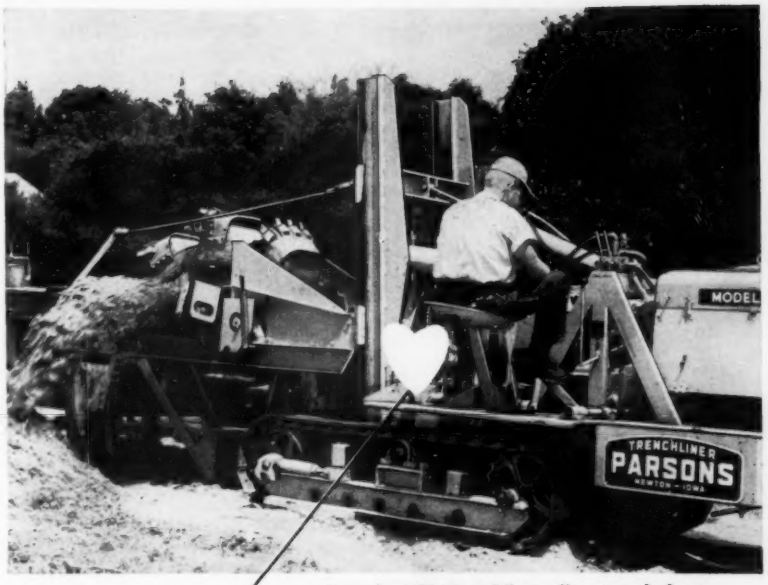
JAMES C. REID is the new president of Southern Union Gas Co., Dallas. He succeeds C. H. ZACHRY, who is retiring after serving as a Southern Union officer for 27 years, the last 15 as president. Reid has been with Southern Union for 25 years, for the past eight as executive vice president. Other newly elected officers include: SCOTT HUGHES, executive vice president; A. M. WIEDERKEHR, vice president, gas supply and exploration; N. P. CHESNUTT, vice president and operating manager; and H. V. MCCONKEY, secretary-treasurer. In addition, J. R. COLE, of Santa Fe, becomes senior vice president; Tom Corr, Albuquerque is vice president, northwest division; and E. M. KELLEY, El Paso, is vice president, southwest division. Others include B. F. WOMBACKER, controller and assistant treasurer; A. S. GRENIER, general attorney and assistant secretary; F. D. BRADLEY, assistant treasurer; and MRS. ETHEL JOHNSON, assistant secretary.

R. MELVIN HUNTER was named director of public relations and industrial development for Northern Ontario Natural Gas Co. Ltd., Toronto, and Twin City Gas Co. Ltd. Hunter formerly was general manager of Twin City, headquartered in Fort William. Succeeding Hunter in the Fort William post is F. IRVING YEWMAN.

GEORGE R. WOEHLER, vice president and comptroller of Southern Indiana Gas & Electric Co., Evansville, has been elected a director. He succeeds EDMUND F. ORTMEYER.

C. H. Zachry
Southern Union

J. C. Reid
Southern Union



Parsons 130 Trenchliner digs trench from 12 to 24 inches wide — depths to 5¾ feet.

The heart of 130 Trenchliner is GUARANTEED FOR LIFE

The head-shaft, heart of the trencher, gives and takes about all there is in ditching service. *Parsons guarantees their 130 head-shaft for a lifetime of service!* Here's why:

Head-shaft assembly starts with special alloy shafting stock — extra large, of course! It is treated and hardened to stand the rugged digging gaff, rides on heavy-duty antifriction bearings. Last, but no less important — drive sprockets are *bolted* to a shaft sleeve to protect the shaft and absorb torsional strains and loading shocks.

This is but one of the reasons for the 130's popularity in gas line service. Your Parsons distributor can give you many more. See him soon.

P19

PARSONS HEAVY DUTY

PARSONS COMPANY
NEWTON, IOWA

A Division of KOEHRING Company

HAYS®

all Brass GAS STOPS

for...

SERVICE LINES
Low, Medium and High Pressure

METER SETTINGS
Flat Head • With or Less Check
Lock Wing

INDUSTRIAL USE
Three-Way • Graduated Dial

APPLIANCES and EQUIPMENT
Lever Handle • Square Head
Flat Head
A.G.A. Listed Control Valves

GENERAL PRODUCTS DIVISION
HAYS MFG. CO.
ERIE, PA.

Four staff members of Commonwealth Natural Gas Corp., Richmond, Va., have been elected vice presidents. CHESTER E. STARKEY, assistant to the president, is now vice president; OSMOND T. JAMERSON, director of public relations, is vice president, public relations; PAUL H. RILEY, superintendent of measurement and dispatching, is vice president and chief engineer; and HARVEY S. GERMAN, superintendent of pipelines and construction, is vice president, maintenance and construction.

RICHARD A. WINSLOW has been elected vice president, sales, and WALTER E. SWANSON, treasurer, of Greenwich (Conn.) Gas Co.

MARJORIE SEWELL has joined Southern California Gas Co., Los Angeles, as a special speaker. She will present a series of talks designed specifically for women's clubs and social groups.

Q. W. WELLINGTON, vice president of operations for Central Illinois Light Co., and HAROLD P. RODES, president of Bradley University, are new directors of Central Illinois.

FRANCIS A. CURRY has been named community relations assistant in Rockwell Manufacturing Co'.s public relations department. He formerly was headquarters personnel manager.

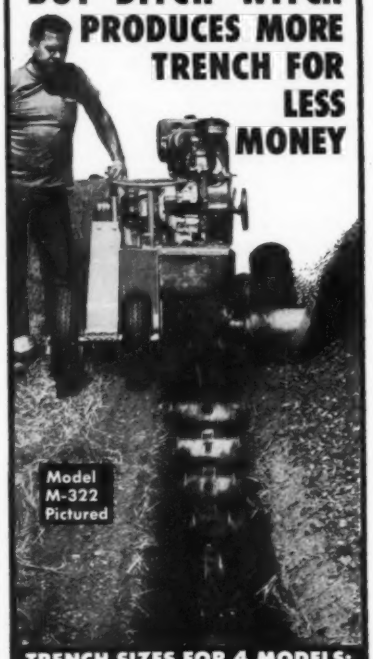
GEORGE B. TUGGLE has been named senior vice president of Honolulu Gas Co. Ltd. He succeeds L. LYMAN GOWANS, who has retired. Gowans continues as a member of the board. Tuggle joined Honolulu Gas in 1946 as a construction and maintenance engineer at the Iwilei gas manufacturing plant. In 1950 he became plant superintendent and in 1956 was named vice president.

DANIEL O. KREITZMAN heads Northern Indiana Public Service Co.'s newly created northeastern division. The new division is a combination of the South Bend and Goshen divisions. Kreitzman will headquarter in South Bend.

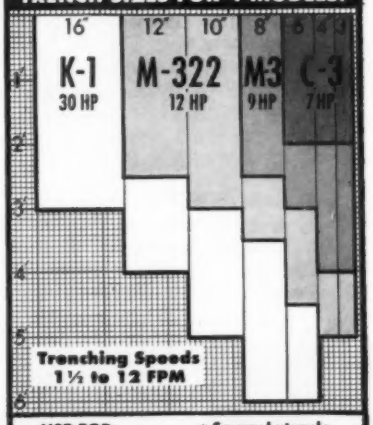
LOREN J. SIMER has been named product sales manager for Carlon Products Corp.'s plastics sewer and drain pipe division. He formerly was Carlon's Midwest regional sales manager. He will headquarter in Aurora, Ohio.

Continued on page 86

"More or Less"
THE BEST
DITCH WITCH TRENCHER
Other trenchers cost "More or Less"
Other trenchers dig "More or Less"
BUT DITCH WITCH PRODUCES MORE TRENCH FOR LESS MONEY



TRENCH SIZES FOR 4 MODELS:



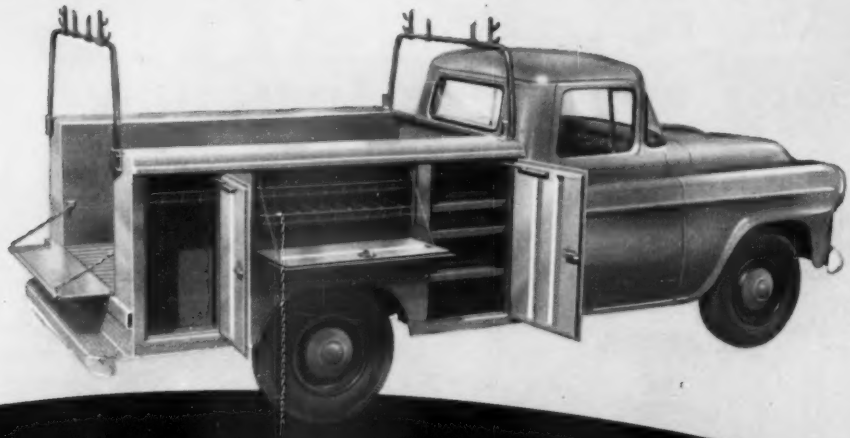
USE FOR:
• Utility Services
• Gathering Lines
• Signal Lines
• Sewer Laterals
• Road Crossings
• Sprinklers
• Footings, etc.

CHARLES Machine Works, Inc.
626 B Street • Perry, Okla.

To Locate Distributor, Look Under "Contractors Equipment" in 1960 Metropolitan Telephone Directory Yellow Pages for Ditch Witch Trademark; or Call Collect FE 6-4404, Perry, Okla.

SERIES 22

SERVICE AND MAINTENANCE BODIES



Four Models . . . Four Sizes

COMPARTMENTIZED TO FIT SPECIFIC JOB NEEDS

Which Series 22 Body do you need? Take a look . . . there's a model especially designed for your particular type of service work. The durable, all-steel unit shown above, equipped with an optional overhead rack, is widely used for general service work in all operations. Other models for electric, telephone and gas service have similar compartments fitted with various shelves and bins to meet specific work needs. Result: You get a custom-made body at a mass-produced price . . . plus increased crew efficiency on every job.

Series 22 Body features include flat, 16-gauge compartment tops . . . rust-proof, cadmium-plated door latches . . . nylon bushings in all door hinges . . . key-locking, weathertight doors . . . recessed, slam-action door catches . . . corrugated steel floor.

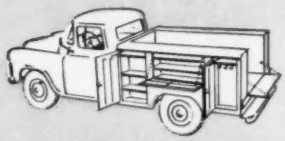
Available in 75", 90" and 104" lengths, equipped with accessories to fit your particular need.

Need more storage space? Any of the four Series 22 models can be furnished with an all-steel superstructure. In addition to any optional items desired, the superstructure is fitted with two full-length shelves and three swivel hooks on each side, a window in the head panel and grab handles at the rear.

Self-Elevating Ladder Assembly

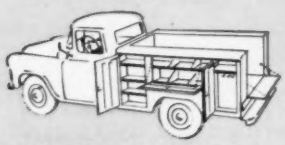
This time-saving assembly with six rubber-covered rollers and four powerful coil springs enables one man to quickly and effortlessly erect a ladder up to 36′ in length. The operator lightly pushes the end of the ladder down, and the springs do the lifting. Stowing is equally fast and easy. Ideal for use on 75", 90" and 104" bodies. Includes 28′, 30′, 32′, 34′ or 36′ two-section extension ladder.

FOR ELECTRIC WORK



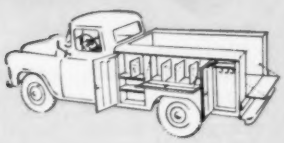
Series 22-E. Designed for service work in any phase of the electric utility industry. Special shelves and bins carry all the equipment and materials needed in the field.

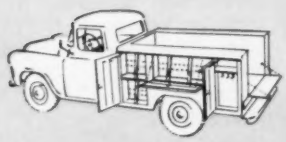
FOR TELEPHONE WORK



Series 22-T. Compartmentized to carry a variety of telephone service tools, parts and materials. Standard arrangement of shelves and bins enables crewmen to quickly find items needed on the job.

FOR GAS WORK





Series 22-G. Two variations of this model are available for carrying either cast or tin meters. Rubber-padded compartments insure the safe storage of fragile parts and instruments.

Plenty of additional bins, shelves and racks carry tools, pipe, fittings, parts and all other equipment needed on routine or emergency service and maintenance calls.

Another reason why
UTILITIES EXPECT MORE FROM

POWERS American

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BERKELEY 10, CALIF.

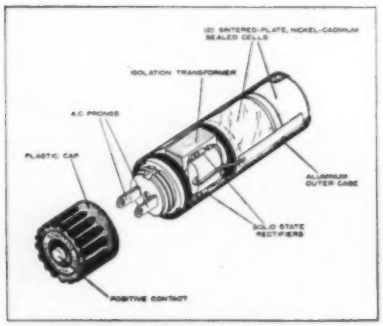
1461 E. Washington Blvd.
LOS ANGELES 21, CALIF.

5525 S.E. 28th Ave.
PORTLAND 2, ORE.

GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 83, 84



1. Rechargeable batteries

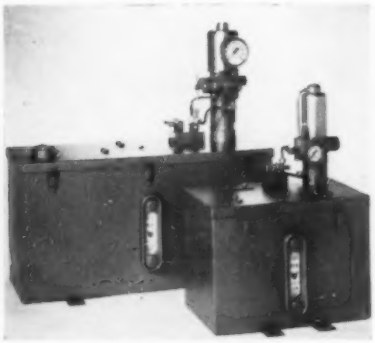
New long-life industrial rechargeable battery cartridges give servicemen batteries with a lifetime of use at a fraction of the cost of constantly replaced cells. The cartridge fits in most flashlights in common use. Overnight charging gives several hours of steady, reliable light. *GEC-770*
Sonotone Corp.

3. Welding fittings

Midwest Pipeline Co. has added seamless carbon steel welding fittings to its line of welded-type fittings. All types are available, ranging in sizes through 24 in. Midwest has machined both inside and outside of the seamless fittings to assure circle-perfect roundness. *GEC-370*
Midwest Pipeline Co.

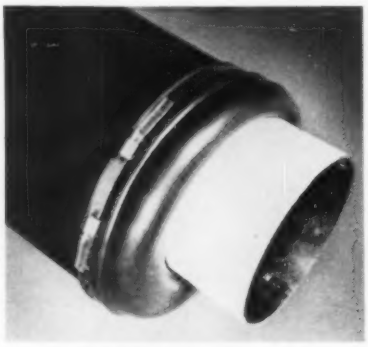
5. Indicating transmitter

Foxboro has a new line of pneumatic indicating transmitters. They are for pressure, flow, temperature, liquid level, differential pressure, dew point. Measurement elements of Model 45 are designed for each major process variable. Easy adjustment and maintenance are claimed. *GEC-540*
Foxboro Co.



2. Lubrication

A new, compact, automatic lubrication system for compressor and power cylinders has been developed by Meter-Pak. The pneumatic system delivers lubricant in precise amounts consistently and at prescribed intervals. Available in four models, Meter-Pak has pressure ranges up to 7000 psi. *GEC-170*
Meter-Pak

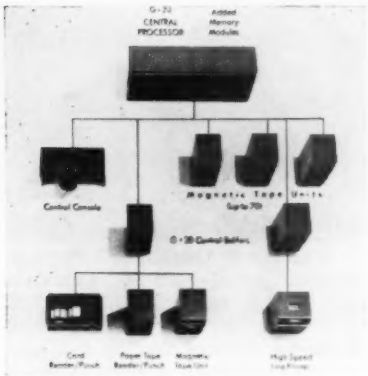


4. Casing seal

"U-Seal" is a new flexible casing seal from T. D. Williamson. The compound used has fungus and bacteria retardant added. The "U" design provides maximum flexibility for any crossing installation. Seal is maintained regardless of the change in pipe position in relation to the casing. *GEC-390*
T. D. Williamson Inc.

6. Thread compound

When applied directly to pipe threads, Dodge Fibers' thread seal tape forms a complete, permanent seal. Made of Teflon, the tape is not affected by acids, gases, steam, atmospheric conditions, high or low temperatures. It also prevents threads from rusting or corroding together. *GEC-730*
Dodge Fibers Corp.

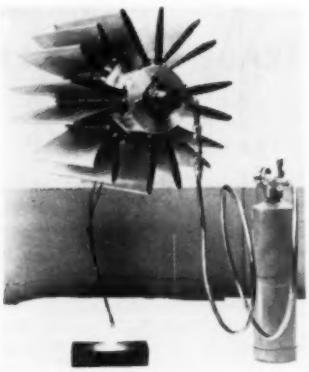


7. Data processing

Bendix G-20 is a new electronic data processing system for high-speed scientific, business, and industrial use. The system is capable of 45,000 floating point operations per second. It offers versatility, expandability, and high computing power. The system is all solid-state. *GEC-180*
Bendix Aviation Corp.

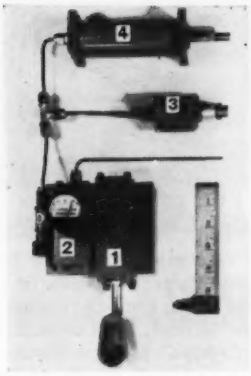
8. Inhibitive primer

Koppers' new cold-applied, inhibitive primer is for use in contaminated atmospheres. Bitumastic 11-S serves a dual role: as a shop primer to prevent contamination from attacking the surface before protective coating can be applied; and to avoid undercutting where mechanical damage produces breaks in the protective coating—after applied. *GEC-610*
Koppers Co. Inc.



9. Thermoelectric generator

A new 1-ft high, 10-lb, automatic "power plant" can produce electricity for a year on $10 worth of ordinary propane gas. The power plant keeps running as long as the fuel supply lasts. Projected use of the generator includes automatic instrumentation for pipelines. *GEC-140*
General Instrument Corp.



10. Safety control system

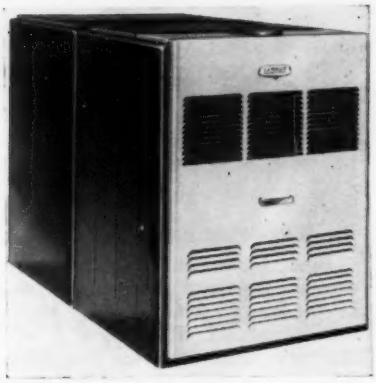
The non-electric Calcon safety control system is sensitive to a wide range of temperatures, pressures, or both in combination. It operates through a small captive charge of compressed air. It puts into operation almost any type of pilot-operated valve, switch, warning, or other control. *GEC-200*
California Controls Co.

11. Control system

A control system for automatically starting, loading, and shutting down internal combustion engines has been developed. It is designed specifically to meet needs of gas compressing applications. The pneumatically actuated control system incorporates safety functions that react to malfunction of any one of an unlimited number of measurable variables. *GEC-170*
Fulton Sylphon Division

12. Molding tape

M-45 molding tape is an easy-to-handle pipe insulating putty. It is used as a conformable permanent filling material prior to overwrapping. Jobs include filling shoulders underneath pipe caps, reducing sharp angles of joints and tees, smoothing rough edges of elbows or valves. *GEC-130*
West American Rubber Co.

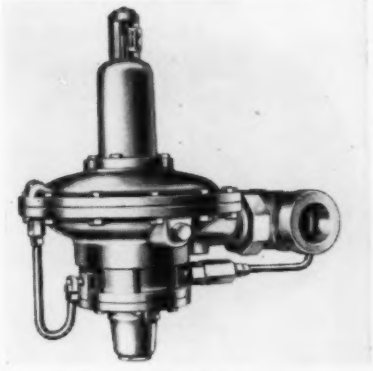


13. Low-boy furnace

Lennox has added a 200,000-Btu "low-profile" gas furnace to its line of forced air furnaces. The 39¾-in. high furnace is ideal for installation in a basement or low-ceiling equipment room in a split-level house. It leaves enough headroom to add a cooling coil on top. *GEC-420*
Lennox Industries Inc.

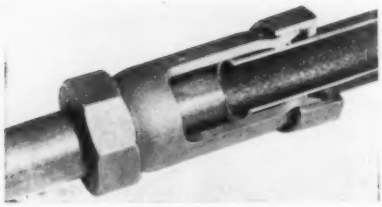
14. Duct furnace

Gas-fired duct furnaces from Reznor are used in an air-handler that heats, cools and ventilates several building zones simultaneously. Model GMZ Multizone air handler is a central system that replaces several units that would independently heat or cool the conditioned spaces. Reznor's duct furnaces are located within the Multizone unit. *GEC-410*
Reznor Manufacturing Co.



15. Travel indicator

Fisher Governor is producing an easy-to-read travel indicator. It is for attachment to Type 99 high pressure gas reducing regulators. Indicator plate is graduated in per cent of valve opening. Traveling portion, colored red, is encased in a Pyrex glass tube for permanent protection. *GEC-700*
Fisher Governor Co.



16. Malleable couplings

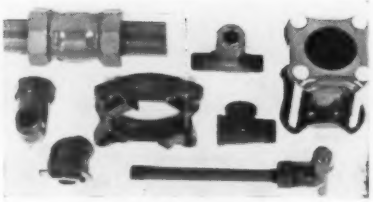
Pipe deflection has been increased to about 6 deg on a side in the new Normac line of malleable couplings. They have a wall thickness that is twice the thickness of the wall of standard steel pipe on which they are used. Available in standard pipe sizes, ¾-in. through 2-in. *GEC-370*
Norton-McMurray Mfg. Co.

17. Cooking center

Ease of installation, compact dimensions, 3-way versatility are highlights of Roper's Maitre D' drop-in gas cooking center. Conversion from rotisserie to vertical broiler is done simply by removing the rotisserie spit and inserting the twin adjustable broiling racks. *GEC-240*
Geo. D. Roper Corp.

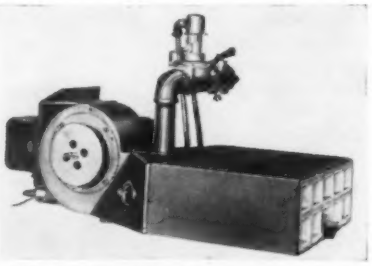
18. Bellows meter

Brown's new bellows meter is for flow and liquid level meter jobs that do not require recording or transmission. Typical uses of the mercury-less meter are for indicating gas, steam, air and water volume, or cuts from fractionating towers. Fifteen differential ranges are available. They can be changed in the field. *GEC-560*
Minneapolis-Honeywell



19. Pipe coating

An epoxy resin coating for pipe corrosion prevention can be readily applied to irregular shapes, such as pipe fittings. Minnesota Mining's "Scotch-kote" pipe protection resin No. 101 applies evenly to all surfaces, providing a finish with high electrical and mechanical strength. *GEC-130*
Minnesota Mining & Mfg. Co.

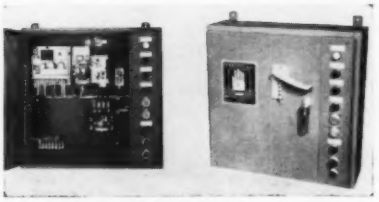


20. Automatic burners

Mettler's Junfor Fan-Air gas burners have new input capacities —from 100,000 to 3.5 million Btu per hr. Operating with air from a low-speed fan, the Junior-size gas burners feature removable gas jets which atomize unrestricted air and metered fuel supply in each of four burner ports. *GEC-410*
Mettler Co. Inc.

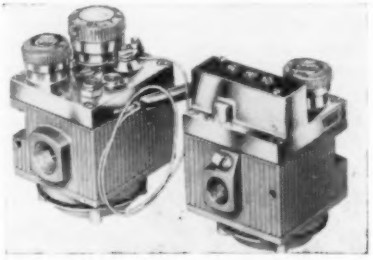
21. Data logger

A new Data Logger system automatically balances from 1 to 1000 bridges and logs their millivolt output signals in a programmed mode. It samples 210 channels of analog data per minute sequentially, commutates and converts them, and punches tabulated data in a paper tape at the rate of 60 5-digit characters per sec. *GEC-180*
Consolidated Electrodynamics



22. Control panels

A series of "packaged" Protectal control panels offers automatic start, stop, and complete combustion supervision of gas-fired ovens, furnaces, various heating and heat-treating systems. A wide range of single or multi-burner installations can be handled without additional engineering. *GEC-190*
Protection Controls Inc.



23. Gas valve

All control knobs and adjustments are accessibly located on one surface in a new straight-through gas valve, developed especially for space heaters. Model 159 controls temperature in either of two basic ways: mechanically (left in photo) or electrically (right). *GEC-420*
Controls Co. of America.

TRADE LITERATURE

24. Two-way radio school

Principles of operating and servicing two-way radio equipment are covered in a home study course offered by Motorola Training Institute. The 38-lesson course covers such areas as system analysis, preventive maintenance, use of test instruments, and operation and servicing transistorized power supplies and receivers. *GEC-140*
Motorola Inc.

25. Gas regulators

Reynolds pilot loaded gas regulators are covered in a two-color, four-page brochure. The booklet, which can be added to Reynolds general catalog, covers four PL regulators. *GEC-700*
Reynolds Gas Regulator Co.

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26. Protective coatings

A 13-page illustrated booklet describes coal-tar protective coatings that are particularly suitable for use on buried or immersed steel and concrete structures. Detailed specifications, resistance properties and typical uses are included. *GEC-130*
Allied Chemical Corp.

27. O-ring design

A 24-page design and data handbook on Viton O-rings as high temperature seals has been published. Included in handbook 5711: test information on some 150 gases and fluids to which the O-rings are compatible; recommended design techniques; compounds and dimensions; and a considerable amount of general information. *GEC-390*
Parker Seal Co.

28. Range sales help

"How to 'Strike Gold' Selling Gold Star Ranges" is a demonstration manual to help retail gas range salesmen dramatize the Uni-Matic flame selector thermostatic gas range top burner. The 24-page, pocket-size booklet presents step-by-step procedures for five simple demonstrations. *GEC-450*
Harper-Wyman Co.

29. Plant equipment

"Products For the Plant" is an 8-page brochure for those interested in selecting and supervising plant equipment. Standard reciprocating, axial-flow, and centrifugal air compressors; centrifugal pumps, steam condensors, steam-jet ejectors, vacuum pumps, air hoists, and air and electric tools are all covered. *GEC-160*
Ingersoll-Rand Co.

30. Jet-driven turbine

An eight-page brochure describes concepts and operating characteristics of Cooper-Bessemer's 10,500-hp RT-248 gas turbine. Development of the unit is covered, and thermal efficiencies, maintenance costs, and potential uses are presented in brochure No. 95. The gas generator section, built by Pratt & Whitney, is based on the J-57 jet engine. *GEC-170*
Cooper-Bessemer Corp.

31. Thermocouple assemblies

A new 40-page catalog describes over 100 complete thermocouple assemblies in detail. Catalog G-100-1 includes prices, specifications, photos, dimensions, and ordering information. *GEC-540*
Minneapolis-Honeywell

32. Inverter unit

Of special interest to users of microwave communication is a new bulletin on Instapac. The four-page folder tells how this Onan-developed transistorized 1 KVA inverter unit supplies instantaneous a.c. power to the load on interruption of commercial power. *GEC-140*
D. W. Onan & Sons

33. Lab analysis

Instruments for lab analysis, process control and research are described in a 16-page general catalog. Techniques and instruments for leak detection, mass spectrometry, chromatography, moisture monitoring, and other types of analysis and control are covered in Bulletin 1313. *GEC-540*
Consolidated Electrodynamics

34. Multipoint recorder

Four-page specification 153-23 describes Honeywell's new Universal Multipoint recorder. The instrument allows changes from 2 to 24 points within seconds. Kits are available for each point, range, or actuation change. *GEC-540*
Minneapolis-Honeywell

35. Gas chromatographs

Beckman's 120-A and 220-A industrial gas chromatographs are discussed in a 12-page bulletin (GC-4018). Complete details and specifications on construction, performance, operating features, and applications of the instrument are included. *GEC-460*
Beckman Process Instruments

36. Combustion safeguard

Webster Engineering has published a 20-page catalog on control centers and systems for combustion safeguard and automation. Design data and starting sequence for nine control centers are presented. *GEC-170*
Webster Engineering Co.

37. Pipe coating

Epoxy-Kote 695 which protects metal pipe against corrosion and abrasion is covered in new literature. Application photos are featured. *GEC-130*
Carl H. Biggs Co. Inc.

38. Instrumentation

A four-page data sheet (NY2-1) is a guide to selecting the necessary components — scale, chart, circuit panel, etc.—to change the range of any standard Speedomax H instrument. A master table lists basic items needed to change range. Individual tables list specific part numbers for each type of range. *GEC-540*
Leeds & Northrup Co.

39. Malfunction detector

Model 65 Vibraswitch is covered in Technical Bulletin RF-586. The detector gives maximum protection for large motors, pumps, compresors, and other rotating equipment by responding to mechanical malfunctions the instant they occur. Installation and operating principles are covered. *GEC-200*
Robertshaw-Fulton Controls

40. Saddles

Full-encirclement saddles are described by Steel Forgings in a catalog sheet. The Fleet-Line saddles need neither bottom weld nor bell-hole excavation. *GEC-620*
Steel Forgings Inc.

41. Pneumatic valves

Conoflow's Bulletin HB-7 covers the company's complete line of pneumatically actuated Saunders valves. Included is a section on valve sizing and flow co-efficients to aid in selection. *GEC-820*
Conoflow Corp.

42. Scrubbers and cyclones

Ejector-venturi, venturi throat, condensing, and cyclonic scrubbers and cyclonic separators are covered in Bulletin 4R from Schutte & Koerting. A discussion of the equipment's use is followed by application, construction and operation information. Tables of gas-handling capacities are also presented. *GEC-720*
Schutte & Koerting Co.

people • *Continued*

from page 78

PETER KASSAK has joined Elizabethtown Consolidated Gas Co., Elizabeth, N. J., as chief engineer. He formerly was with Public Service Electric Gas Co. as district superintendent.

Several men have been promoted in Southern Counties Gas Co.'s general office headquarters. D. E. SHIVELY is now administrative specialist in the customers' department. R. H. WATSON is staff supervisor, reporting to the manager of budgets and reports. J. R. LEMAN is staff supervisor in the customers' department. And, M. P. WALKER succeeds Shively as supervisor of stores in SoCounties purchases and stores department.

J. R. Leman
SoCounties

R. H. Watson
SoCounties

M. P. Walker
SoCounties

D. E. Shively
SoCounties

WESLEY H. BLAYLOCK has been named southeastern sales representative for Maxitrol Co., Detroit. Blaylock will cover seven southeastern states from his headquarters in Chattanooga, Tenn.

RANSOM M. COOK, president, chief executive officer and director of Wells Fargo Bank American Trust Co., has been elected a director by Pacific Gas & Electric Co., San Francisco.

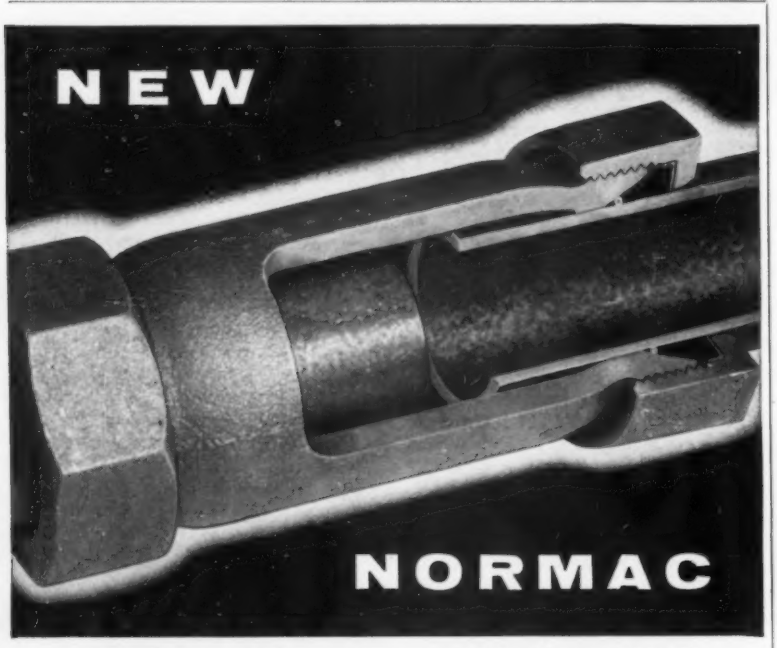
MRS. SYBIL HOUSEHOLDER SHEARER has joined Washington Natural Gas Co., Seattle, as home service director. She succeeds MRS. BETTY BELL.

ANTHONY J. DEMSE has joined North Shore Gas Co., Waukegan, Ill., as assistant to the president.

NORMAN B. BERTOLETTE has retired as chairman of the board of the Hartford (Conn.) Gas Co. He will continue as a member of the board. He is bringing to a close a distinguished career of nearly half a century in the utility business. He joined the Philadelphia Suburban Gas & Electric Co. in 1911. Early in 1930 he was elected president of the Harrisburg (Pa.) Gas Co. He resigned that post in 1935 to become president of Hartford Gas Co. In 1957 he was elected chairman of the board.

JAMES M. LEINENKUGEL has been appointed product manager-distributive products for A. O. Smith International S. A.

WILLIAM H. BRITTAIN has been promoted to supervisor of Eastern Canadian activities for Heath Survey Consultants Inc., Wellesley Hills, Mass. He headquarters in Montreal. Before his promotion, Brittain was senior consultant at Heath.



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Get helpful CATALOG 12. Photos, specs, detail drawings & much helpful data for modernizing or new installations.

MALLEABLE SERVICE ELL
Maximum stab. All sizes, with or without insulating gaskets. Also in brass 1¼ I.P.S.

BRASS FITTINGS
The most complete line for copper or plastic tubing in ⅝, ⅞, 1⅛, 1⅜ O.D., 1¼ I.P.S.

Top Quality for 22 Years in Gas Distribution Equipment

PERMANENCY Rely on NORTON-McMURRAY for the finest! NORMAC continues to modernize and improve couplings and fittings in step with latest gas distribution demands. 22 years experience concentrated on ONE purpose . . . the BEST! Today, major gas distribution companies say "NORMAC" to define their standard of quality.

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Model G

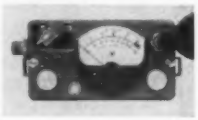
Model H

Testing barhole for gas leakage

Two J-W portable gas detectors give reliable, trouble-free service

J-W SNIFFER, Model G, is used for a general-purpose combustible gas detector. Scale is graduated from 0-1.0 l.e.l. (lower explosive limit) for all common gases and vapors. Light in weight (4 lbs.), simple to use and maintain.

J-W GAS-POINTER, Model H is ideal for testing barholes for underground leaks in natural gas lines. Also used for testing manholes, valve boxes, etc. Two scales: 0-1.0 l.e.l. and 0-100% (pure) gas. Exclusive design eliminates electrical switching or zero shift when changing from one range to the other.



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H. P. Letton Jr.
SoCal

James Preston
Michigan

HARRY P. LETTON JR. has been elected vice president and general counsel for Southern California Gas Co., Los Angeles. He succeeds T. J. REYNOLDS, who first joined SoCounties in 1922 and has served as vice president and general counsel since 1927. Letton has been general attorney for the company since 1957, a director since 1958. He joined SoCounties in 1951 as assistant general counsel.

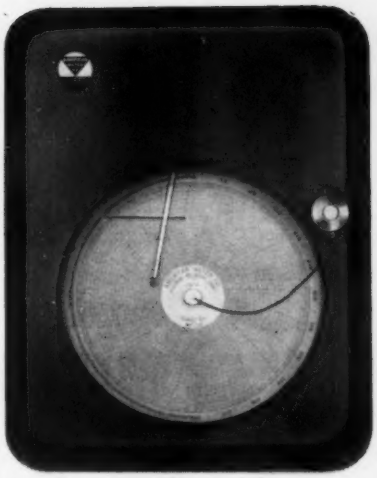
JAMES C. PRESTON has been promoted to general manager of Michigan Consolidated Gas Co.'s operations in central and northern Michigan. He has been manager of the Cadillac district. RENO J. MACCARDINI was promoted from northern districts engineer to assistant general manager. Both men headquarter in Mt. Pleasant. THOMAS K. HORTON succeeds Preston as manager of the Cadillac division. He has been sales and office supervisor in Mt. Pleasant.

Robertshaw-Fulton Controls Co. has named THOMAS M. ISAACS director of advertising and sales promotion and BEVERLEY L. BRITTON director fo public relations. Both men will headquarter in Richmond, Va. Isaacs has been program supervisor of industrial advertising for Reynolds Metals Co. Until recently, Britton was manager of the news bureau of the Baltimore (Md.) division of the Martin Co.

FRANK C. PACKER has joined the staff of Regent Jack Manufacturing Co. Inc., Downey, Calif.

B. L. Britton
Robertshaw

Thomas Isaacs
Robertshaw



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- High sensitivity and torque—fast speed of response.
- Standard 0-150°F. range. Other ranges available by request.
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VALVES

YOU CAN RELY ON REYNOLDS RELIEF VALVES . . . safe as a ball over the centerfield wall!

BUY REYNOLDS RELIEF VALVES for every over-pressure protection need: Mechanical (Pop Valve Type) Diaphragm-Operated. Mercury Seal. Lever and Weight. Pilot-Loaded

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A SUBSIDIARY OF ARKANSAS LOUISIANA GAS COMPANY

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SAFETY GAS MAIN

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GOODMAN USED SINCE 1897 2" HANDLE & LOCKING SLEEVE GAS MAIN STOPPER

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Cable Address GASTOPPER, N. Y.

Wallace Miller
Motorola

John Fussell
Motorola

WALLACE P. MILLER is now manager of two-way radio sales in the Midwest for Motorola Communications & Electronics Inc. From his Chicago headquarters, Miller will supervise sales in a 13-state area, extending from Ohio to the Dakotas. Succeeding him as sales manager in New York is JOHN F. FUSSELL. His most recent assignment was regional manager for Maryland, Virginia, and the Carolinas.

KEN BAYLESS has been named vice president-sales of Cal-Metal Pipe Corp. of Louisiana, Baton Rouge. He formerly was assistant sales manager.

HARRY H. SPEAKES has been named western district manager of American-Standard Air Conditioning Division's western sales district. He formerly was Seattle district representative. Four new representatives have been named. ELMER L. JACOBS takes over for Speakes in Seattle; RALPH W. MCCARTY covers the San Francisco territory, including northern California and Nevada; LOU POLETT, in the Los Angeles district, covers southern California and Arizona; and WALTER A. HABERL, in the Denver territory, covers Denver, Colorado Springs, Salt Lake City, Albuquerque, and El Paso.

W. C. HENDERSON has been named manager, utility sales, and A. W. LEIGHTON, manager, industrial sales, Los Angeles district, by Allis-Chalmers Industries Group.

Pittsburgh Coke & Chemical Co.'s Coke & Iron Division has named ROBERT W. HANLON general superintendent and EUGENE R. DEAN assistant general superintendent.

J. D. GREENSWARD has been elected president of Canadian Allis-Chalmers Ltd. He succeeds HAROLD M. SCHUDT, newly named director of manufacturing, Allis-Chalmers International.

And NOW... Another All-New VERMEER POW-R DITCHER

MODEL 3P THREE POINT HITCH

Here's the new Pow-R-Ditcher that hundreds of contractors, municipal and utility officials have been asking for... the rugged Vermeer Model 3P. Revolutionary in design, the 3P is inexpensive and easy to operate. Fits all standard 3-point tractor hitches and features an all-new *hydraulic actuated forward travel ratchet device* that gives full control of digging speed from one control lever. Highly maneuverable.

DIGS 6" to 16" WIDE—4½' DEEP

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IDEAL FOR LAYING GAS PIPE, WATER AND CABLE LINES—DIGGING FOOTINGS

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Please send me complete information on the all-new Model 3P Pow-R-Ditcher

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1441 W. WASHINGTON • PELLA, IOWA

L. R. MOBLEY has joined Southern Pipe Coating Co., Atlanta, as sales representative in the southeast area.

JOHN J. TUOHY, president of Long Island Lighting Co., Mineola, N. Y., has been named chief executive officer. ERROL W. DOEBLER continues as chairman of the board. FRED C. EGGERSTEDT JR., assistant vice president in charge of the finance department, was elected a vice president.

JOEL M. KIBBEE has been named manager of customer educational services of the Remington Rand Univac Division of Sperry Rand Corp., New York.

DONALD B. BEECHER, president of Equitable Gas Co., Pittsburgh, has been elected a director of the National-Ben Franklin Insurance Co. of Pittsburgh.

Deaths

WILLIS L. LEA JR., vice president and general attorney for Southern Union Gas Co., Dallas. Mr. Lea joined Southern Union's legal staff in 1936. He was elected assistant secretary of the company in 1938, and became general attorney in 1945. He had been vice president since 1955.

J. D. DAVIS, 59, vice president of United Gas Corp., Shreveport. Davis, a veteran gasman, had been with the United Gas organization for more than 35 years. In the past six years he had been pipeline superintendent of the western division of United Gas Pipe Line Co., a director of the pipeline company, assistant to the president of United Gas Corp., and, since September 1959, vice president of the corporation.

ALBERT BABCOCK MCCOARD, 70, vice president and principal financial officer of New Orleans (La.) Public Service Inc. Mr. McCoard was with NOPSI and its predecessor companies for more than 56 years, starting as an office boy in 1903. An authority on public utility financing, Mr. McCoard had been a director for over 25 years and a vice president since 1939.

HERMAN W. SHUBRING, gas transmission marketing consultant for Clark Bros Co., Olean, N. Y. For the past nine years, Mr. Shubring was with Clark Bros. Before that he was with Ford, Bacon & Davis Inc. and Northern Natural Gas Co.

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1. SLOW-SPEED OPERATION
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- American® AL-250 Aluminumcase Meters operate at only 7 revolutions per cubic foot providing ample power, greater accuracy and longer life.
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HARRY CAIN, 60, assistant to the public relations director of United Gas Corp., Shreveport. Cain was a veteran of 24 years with United Gas. He joined the company in Houston in 1936 as a dealer sales coordinator, then became sales supervisor at Longview, Texas. He was promoted to manager of the Lufkin office in 1942, and in 1944 became district manager in Longview. He was assistant division manager in Beaumont in 1949 and 1950, prior to his move to the public relations department in Shreveport.

RAYMOND H. LEWIS, 52, general sales manager for the Buflovak Equipment Division of Blaw-Knox Co., Buffalo, N. Y. Mr. Lewis had been with the company for 25 years. He was named general sales manager in 1957.

R. E. BROOKS, 77, pioneer in the packaged boiler industry. Mr. Brooks teamed with J. C. Cleaver in 1931 to found Cleaver-Brooks Co. He served as president from 1931 until 1943. From 1943 until his death he served as chairman of the board.

CSI

Practical ideas for BETTER Cathodic Protection

ARE YOU GETTING THE MOST FOR YOUR MAGNESIUM ANODE DOLLAR?

Many corrosion engineers are concerned over the composition specifications of magnesium anodes used to stop corrosion on pipe lines, oil well casing, etc.—and rightly so. But there is a more important factor that is sometimes overlooked. This is the *actual weight* of the bare anode, particularly in backfill-packaged units.

During the past several years an increasing number of the companies that use anodes have found it pays to spot check the metal weight of all anodes purchased. Often the small cost of pulling the anode from the packaged backfill has been worthwhile. 17-pound anodes have been found to weigh as little as 14 pounds, 32-pound anodes from 26 to 30 pounds, and 50-pound anodes only 44 pounds.

We at CSI feel that, regardless of the supplier, a spot check should be made of all anodes purchased. Of equal importance, requests for quotations and the subsequent purchase orders should *define all specifications.* As far back as 1945, the industry set maximum weight deviations for bare magnesium anodes at ±3 per cent of the designated weight. We suggest that, if this condition is specified and checked, you will be getting more for your magnesium anode dollar.

You'll find it to your advantage to check with CSI for engineering and installation services, and for quality supplies for both anode and rectifier installations. Estimates or competitive quotations without obligation. Let our stock-holder-employees demonstrate the economical and satisfactory service they can give you. Call or write today.

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regulatory • *Cont'd.*

from page 11

Louisiana, in the nine southern states in which Southern Bell operates, and in the United States.

"While it may be that no formula can be laid down which will apply uniformly in all cases or to all kinds of utilities yet in fixing a rate of return consideration must be given to the rate of return allowed other utilities similarly situated. In Federal Power Commission v. Hope, * * * the United States Supreme Court said:

'From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on the debt and dividends on the stock. * * * *By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks.* That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit *and to attract capital.*' (Italics ours.) * * *

"In the instant case it is established by the evidence that no utility is receiving anywhere near as low a return as Southern Bell. The disparity is so great that we must of necessity hold that the action of the commission in its end result is discriminatory and that the rates fixed are not just and reasonable under the circumstances. * * *

"It must not be overlooked according to the testimony of Southern Bell's vice president, that heavy construction at high cost levels reduces the earning rate through increasing expenses and investment without corresponding increases in the revenues." * * *

"The large amount of capital necessary to meet the expansion needs of Louisiana, as well as the amount necessary to revise the capital structure to meet the demands of the commission's formula, must be raised in the money markets in competition with other utilities whose stock and bonds are more attractive to investors because of their greater returns. While we are dealing here with intrastate rates only, we cannot

build a wall around Louisiana and say this capital must be raised in Louisiana alone. Even if we adopted such a provincial attitude, there would be no way of preventing utilities located in other states from competing with Southern Bell in Louisiana for Louisiana capital. The answer is there must be no discrimination."

Here is a case that will be repeated in many of the 50 states, because a utility is dedicated to rendering service to all qualified applicants. The growing demands by customers for service, plus the climbing costs of rendering that service, cause an expanding utility to become poor with growth during this economic cycle. Periodic utility rate increases will have to be sought to keep financially able to perform dependable service. Pains, unknown to non-regulated companies, will strike public utilities when they seek price increases. Non-regulated businesses neither have to ask for governmental permission, nor overcome powerful opposition to obtain an increase in the price they charge. ■

corrosion • *Continued*

from page 19

0.90 v; clearly the current requirement is less than 10.0 amp, for this overprotects the line. We now adjust the output downward to 9.0 amp, and it is observed (after some time for possible depolarization) that the P/S falls to 0.84. Thus we have a rate of change of 1/0.06 = 16.6 amp/v; to get the 0.01-v change we need, we shall have to have 0.16 amp, for a total current requirement of 9.16 amp for the new conditions. ■

Washington • *Cont'd.*

from page 17

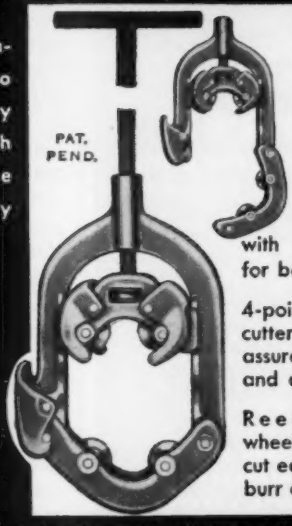
protect him from the limited embarrassment he is suffering.

They may not be able to cause the FPC to lose a chairman. But they have been trying.

There's more than a bit of irony to the investigation. Chairman Kuykendall testified before the same Harris Committee last November—some three weeks after the incident involving Mr. Corcoran

IF YOU CUT LARGE DIAMETER PIPE...
YOU NEED THESE
New REED HINGED 4-WHEEL PIPE CUTTERS
Four sizes cover the range from 2½" to 12"

Users tell us these completely new cutters are so efficient they often "pay for themselves" through the savings in crew time on a half-dozen cuts. They are the first really practical tools for cutting off steel or cast iron pipe in sizes from 2½" to 12". You can, for example, cut 8" steel pipe completely off in less than five minutes.



Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

Reed Razor Blade wheels track perfectly, cut easily and roll down burr on steel pipe.

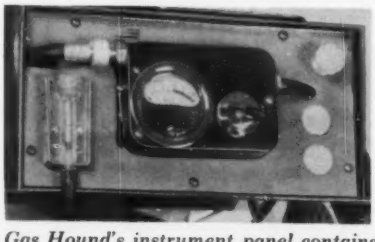
Unconditionally guaranteed to be the most efficient cutter you have ever used. Ask your jobber or write for literature.

REED MANUFACTURING COMPANY
ERIE, PENNSYLVANIA • U. S. A.

Operator just stops the Gas Hound, pushes the hydraulic lever down, reads the explosion meter and raises lever.

Gas Hound backs up to walls to check service entrances. An optional foot probe lets you test anywhere, anytime.

NEW ONE MAN machine
reduces bar-leak survey costs up to 80%



Gas Hound's instrument panel contains (A) probe air flow indicator, (B) explosion meter, (C) probe limit indicator lights and (D) limit light switch.

Three seconds per probe

At the flip of a lever, hydraulic pressure pushes the probe rod into the ground, the sample is taken, the reading is given and the probe removed. One man can make 100 tests an hour! A strong, continuous vacuum lets you detect leaks under streets from the curb and also clears the probing system after each test is completed.

Put your bar-leak survey on wheels with the GAS HOUND

Write for complete information and a demonstration appointment:
THE DETECTO COMPANY Clarion 16, Iowa

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the Concentrated Fuel
GULF GULFTANE LP-GAS
WARREN
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LIQUEFIED PETROLEUM GAS DIVISION
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NEW
Arno
PIPE-WRAP TAPE
Positive Protection for Buried Pipe
Here's pipe protection by the roll. Pipe-Wrap is made of stretchy, inert polyethylene with a pressure-sensitive adhesive to provide a tough, continuous barrier against rust, acids, alkalis and electrolytic currents. Saves time and money.
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—that so-called ex-parte communications on behalf of one side in a contested case be permitted but on condition the communications are in writing and are put into the agency's public file.

All oral communications "should be prohibited," he said. He was commenting on a proposal, still pending, which would outlaw ex-parte communications once a case is set for hearing, and require a summary of any oral contacts be made public.

The FPC hassle leaves natural gas legislation where it has been left so many times before by ill-timed and ill-advised actions which catch the public eye. It's dead, probably for many years.

There is still talk, touched off by President Eisenhower's weak endorsement of the proposal, of a new coalition between coal producers and independent gas producers so that each would get a bone. Coal industry would get national fuels policy study, without gas opposition, and the gas industry would get a natural gas bill to ease federal utility controls without coal opposition.

At the same time, many gas producers are reportedly about ready to give up all such "deals," and simply go ahead and start fighting on their own hook for a natural gas bill. They believe fighting directly for what they want and believe to be right without regard to concessions is the quicker method.

But both of these positions will be met by stubborn and powerful opposition based on simple politics, without regard to any economics.

The proposal now being circulated in Washington for comments, and designed to meet the demands of top Eisenhower Administration officials, would deal only with production and gathering. It would permit pipelines to assign a "reasonable market price" to the gas they buy. FPC would set this price under terms similar to the 1956 bill vetoed by President Eisenhower.

It would define gas as a commodity in the field, making producer certificates unnecessary, and remove any utility-type controls.

This may well be the form of the gas bill to be pushed in the next Congress, when the Harris bill which is now pending will be killed by adjournment. But there is an uphill fight ahead which has again been made steeper by the gas industry itself. ■

Correction

In R, L. Sindell's article on "Modern Electronic Flame Safeguard Control Systems" (GAS, April, pp. 58-65), an important phrase was omitted.

The error appears on p. 61, in the last sentence of the last paragraph under the subhead, "Figure 1."

That sentence should read: "The point of this test is to be certain that the *condition does not exists that the* igniting pilot flame may be sensed by the protecting device but still not be of sufficient size or in the proper location to ignite the main burner." The italicized words were omitted in the April article.

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LOWER SERVICE COSTS
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STOCK this useful tool for every service CAR and CALL •
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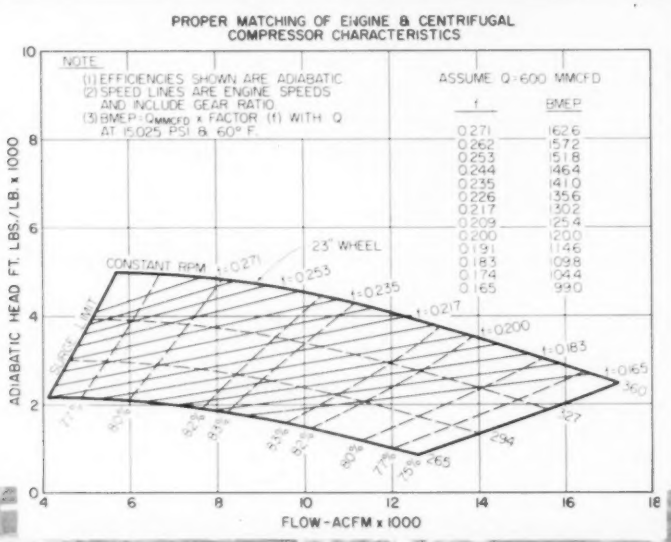
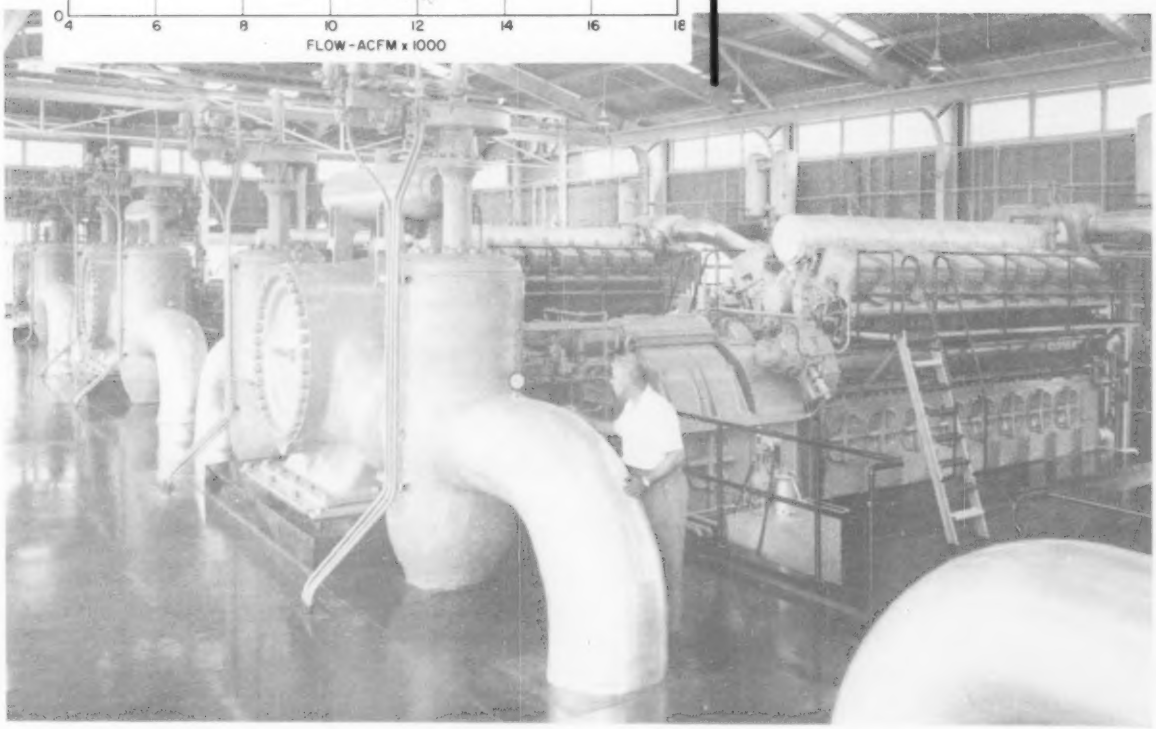
GAS

PIPELINE SECTION



Operating characteristics of

engine-driven centrifugal compressors



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From the moment the raw Asbestos comes out of the Nicolet Asbestos Mines until the Asbestos Felt is shipped to you, care in manufacture and rigid inspection throughout are maintained to give you the finest Asbestos Pipe Line Felts obtainable.

This is the main reason more and more Corrosion Engineers are specifying Nicolet Asbestos Pipe Line Felts with complete confidence. Whether they need Nicolet #15 "Standard", #8 "Tufbestos" or #10 "Reflecto" (the new, improved, white Asbestos Felt) they know they will be providing the best possible pipe line protection.

And now — the addition of "Old Nic" Glass Wrap to the Nicolet line of pipe wrap products makes Nicolet their best source for complete protection — and makes it yours, too.

Write today for complete specifications and samples of Nicolet Pipe Line Products.

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Florham Park, New Jersey

O.K., send me samples and specifications of:

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NICOLET INDUSTRIES, INC.

FLORHAM PARK, NEW JERSEY

Operating characteristics of

Engine-driven centrifugal compressors

By CLARENCE TAYLOR

Gulf Interstate Co., Houston

MODERN, high compression, reciprocating gas engines are the most efficient combustion type prime movers available today. The combination of a high efficient reciprocating engine and the high flow, high efficient centrifugal compressor achieves the highest overall efficiency ever attained in compressing large quantities of natural gas.

The high overall efficiency is expressed in terms of cubic feet of gas compressed per Btu of fuel consumed. On this basis, engine driven centrifugal units are actually able to compress at least 50 per cent more gas per Btu of fuel than the nearest other combustion type prime mover and centrifugal compressor. A possible exception to this statement may exist with gas turbine driven centrifugals, of improved designs.

In 1956, the first two engine-driven centrifugal-compressor combinations were installed. One unit was designed by Transcontinental Gas Pipe Line Co. and the other by Gulf Interstate Gas Co., now the Columbia Gulf Transmission Co. Transco's installation was a partially automatically operated station. Columbia Gulf unit was an automatic, remote controlled station. This difference in design concepts influenced not only the design of control components, but affected all phases of the station design including engines and compressors. Both installations were classed as experimental, not because of the various equipment components used, but primarily because of the unusual combinations of the components. Actually, the major components such as engines, compressors, pipe, valves, cooling towers, etc., all had been proven successful for many years.

FIG. 1. PRINCIPAL ENGINE RATINGS

	Clark Bros.	Cooper-Bessemer	Ingersoll-Rand	Nordberg
	TPV	LSV	PKVT	Supair-thermal
BMEP	110	160	136	160
RPM	330	327	360	500
BHP/CYL	400	275	285	239
No. Cyl.	10, 12, & 16	12 & 16	12, 14, & 16	12 & 16
Cycle	Two	Four	Four	Four
Comp. Ratio	9:1	13:1	12:1	12½:1
Bore	17	15½	16	13½
Stroke	19	22	22	16½
Btu/BHPH*	6600	6200	6300	6350
V type	yes	yes	yes	yes
Turbocharged	yes	yes	yes	yes
Variable RPM**	250–360	240–360	270–360	variable
Comb. air cooling	yes	yes	yes	yes

*Guaranteed fuel consumptions.

**The lower speed limit is normally limited by consideration of torsional vibration of the entire power train, engine, gear compressor and couplings.

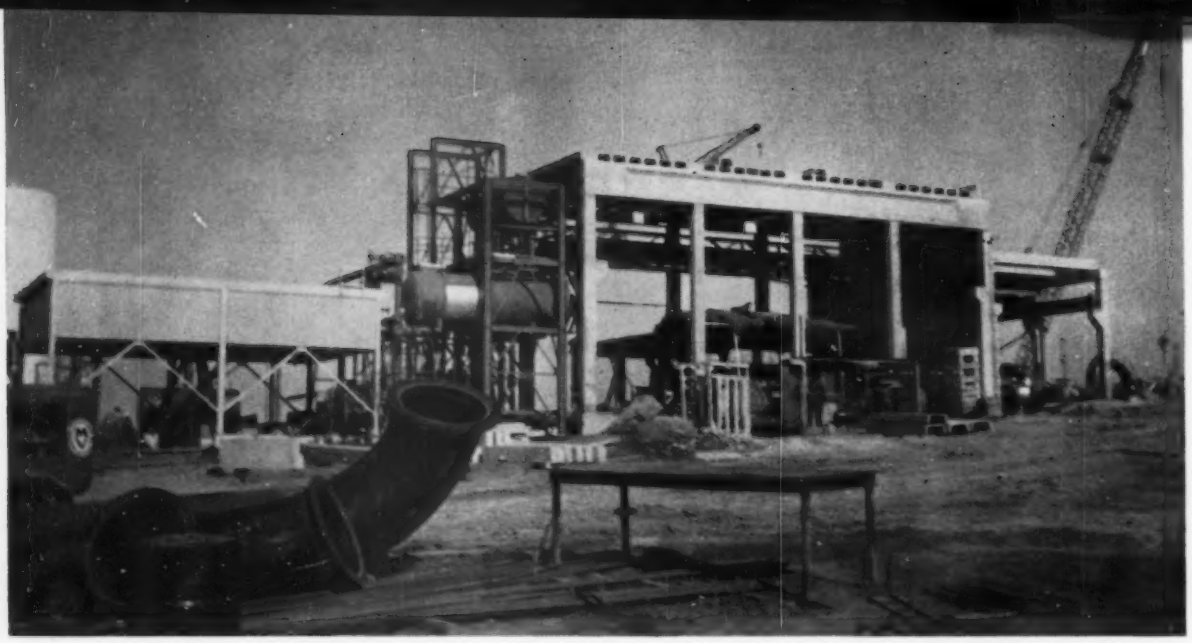


Fig. 2. Two-cycle engine driving a pipeline centrifugal compressor.

The experimental tag was very quickly removed after several months operation. The Columbia Gulf units were so enthusiastically accepted that additional photocopy units were installed at four other compressor stations. A rapid expansion program was completed on that system in late 1957. This program resulted in installation of a total of 20 engine-driven centrifugal-compressor units, for a grand total of 70,000 hp, equally divided into five stations.

In 1960, the first all centrifugal compressor pipeline will go into operation, and all centrifugal compressors will be powered by reciprocating gas engines. This system is, of course, the new Transwestern Pipeline now under construction. (See GAS, May, '60). With completion of this system, the natural gas industry will have a new pattern that will influence future compressor stations and pipeline designs. The year 1960 will also record the introduction to the gas industry of two new large reciprocating engines, specifically designed to drive the centrifugal compressor, although the first installation of one will be to drive reciprocating compressors. Thus, a choice of at least four different reciprocating engines is available to the industry. Each is applicable as a prime mover for the centrifugal compressor.

The four principal reciprocating engine prime movers for centrifugal compressors are identified in *Fig. 1* by trade name or designation and manufacturer. The chart also makes a rough comparison of the engines at rated conditions plus a few other salient facts about the units.

The oldest engine of the four is the LSV unit. It has been in service outside of pipelines since World War II. The Nordberg unit has been in service since 1948. The production prototype TPV unit has been on the test block for some 18 months, and has been installed for field testing in actual pipeline service on Columbia Gulf Transmission's pipeline. It was placed in operation in January. The TPV unit is the first two-cycle engine to drive a pipeline centrifugal compressor (see *Fig. 2*). *Fig. 3a* shows the LSV unit as it is installed on the Columbia Gulf Transmission system. *Fig. 3b* pictures the Nordberg unit installed on the Transco system. *Fig. 3c* shows the TPV unit on test at the factory.

A fourth possible engine prime mover, for centrifugal compressors, is the new four-cycle Ingersoll-Rand PKVT. The original unit has completed more than 18 months of factory tests. The first application of this unit is with reciprocating compressor cylinders, although it was designed to also drive centrifugal compressors. This installation is on the Trunkline Gas Co. system, and was placed in operation during January.

All of the units are quite large not only in physical size, but in horsepower rating. So far, these units are the only ones actually, or will be soon, driving centrifugal compressors in this country. The smaller gas engines have not been utilized for this application, at least in pipeline service, primarily because of the economics involved.

Centrifugal compressors are fundamentally high flow, low head machines and are designed to handle the entire flow of a pipeline with a small compression ratio. A number of these units can be placed in series to produce larger station compression ratios. Centrifugal compressors are normally not employed in parallel operation to produce large ratios with small flow rates, as are reciprocating compressor units. This type of operation is usually uneconomical with centrifugal compressors. *Fig. 4* illustrates the series method of employing centrifugals, on the Columbia Gulf system. *Fig. 5* shows the same method on the Transco pipeline.

It is characteristic of all large reciprocating engines that they operate at relatively low speeds, usually

less than 500 rpm. It is also characteristic of centrifugal compressors that they operate at much higher speeds, generally in excess of 2000 to 3000 rpm. Some centrifugal units operate at speeds up to 20,000 or 30,000 rpm. These characteristics require use of a gear set to provide a proper matching of required speeds.

Fig. 6 shows the gear set employed with Nordberg engines. The gear was designed by DeLaval and manufactured by Nordberg. Note the close coupling between gear and engine. The engine flywheel is not used with this arrangement. The necessary WR^2 effect is supplied by the gear.

Fig. 7 is a close up view of the gear set employed with the Cooper-Bessemer engine. The gear is designed and manufactured by Western Gear Corp. The engine is off to the right of the picture and is not shown. The compressor is located outdoors and the high speed shaft to it is shown on the left side of the picture, passing through the concrete fire wall. This wall is one of the differences in the design concept of the stations previously mentioned. In *Fig. 5* the engine, gear, and compressor are all located within the same building.

It is characteristic of reciprocating engines and gears to have torsional vibrations. The potential torsional problem exists in every combination of engine driven centrifugal compressors. This is one of the major problems involved in using a reciprocating engine to drive the centrifugal compressor. The solution generally determines the minimum speed at which the combination can operate. An engine cannot be designed to operate from zero to its maximum speed without some torsional vibrations above the acceptable limit. Likewise a gear set will have some torsionals.

The centrifugal compressor, by virtue of its speed, does not present a major torsional problem. The combined effects of each of the components could present a major torsional problem. The solution calls for the highest possible degree of engineering skill and cooperation between various manufacturers of components and ultimate users. Without this cooperation and engineering skill, the application is sure to result in a very unsatisfactory installation. The problem is peculiar only to engine-driven centrifugal compressors, and must be realistically faced. The solution may be found in the application of tunable couplings between engine and gear and/or gear and compressor. Satisfactory solutions have also been obtained by tuning a shaft within the gear, complemented by suitable couplings. The successful operation of an engine-driven centrifugal-compressor unit is adequate testimony to satisfactory solutions of the problem.

Another major problem exists in matching the engine to the compressor, and is in part connected with the torsional problem. The solution to the torsional problem generally results in restricting the lower operating speed of the combination. Thus, a good portion of the complete compressor operating envelope is unusable. The power characteristics of the engine must also be matched to the compressor in order to preserve the remaining portion of the compressor envelope.

One of the laws that govern performance of a centrifugal compressor states that the brake horsepower required by the compressor varies with the cube of the speed. The power output of an engine varies directly with the speed. Obviously the engine and centrifugal compressor are inherently mismatched in relation to brake horsepower. *Fig. 8* graphically shows this mismatching.

The solution employed by Gulf Interstate sets the maximum horsepower required by the compressor at its maximum speed, equal to the maximum power developed by the engine also at its maximum speed. Thus the horsepower required by the compressor at any lower speed will obviously be less than the maximum power that the engine can develop at that same speed. This has actually derated the engine to some horsepower less than its maximum at its rated speed. If the matching point was selected to occur at the design speed, and this may seem to be the obvious point, the horsepower required by the compressor at speeds greater than the design speed far exceeds that actually available from the engine. As a matter of fact, this condition will occur if the matching point is set at any speed less than the maximum speed. In reality, the straight line in *Fig. 8* is a line of constant BMEP. It is also a line of maximum permissible, constant, BMEP that the engine can develop.

The concept of power matching as employed by Gulf Interstate requires use of BMEP as a parameter of engine performance. BMEP is a simple abbreviation: Brake Mean Effective Pressure. Since it is a pressure it is expressed in terms of pounds per square inch. By definition, BMEP is that constant, net average, pressure which, by acting on the face of a piston throughout one stroke, would produce the network of a single complete cycle. The equation for BMEP is:

$$\text{BMEP} = \frac{33{,}000 \times \text{BHP}}{\text{LANC}} = \text{Constant} \frac{\text{BHP}}{\text{N}}$$

Where BMEP is in psi; BHP is the brake horsepower of the unit; L is the length of the stroke in feet; A is the area of the piston on which the pressure acts in square inches; N is the number of power strokes per minute; and C is the number of cylinders in the engine.

Engine manufacturers have long recognized the importance of BMEP as a parameter of engine performance, and as an index that relates the size of an engine to its work output. One objective of engine makers is to design an engine with a high thermal efficiency and also a high BMEP. Thermal efficiency is a major factor contributing to low cost of operation; high BMEP is a factor contributing toward a smaller size compact engine, having a lower manufacturing cost, and lower installation costs.

The gas industry failed to place much importance in BMEP, particularly in operating an engine. Many gas engineers recognized the importance of using BMEP to compare different engines and some rated performance of an engine while on test in terms of its BMEP. Practically no importance was attached

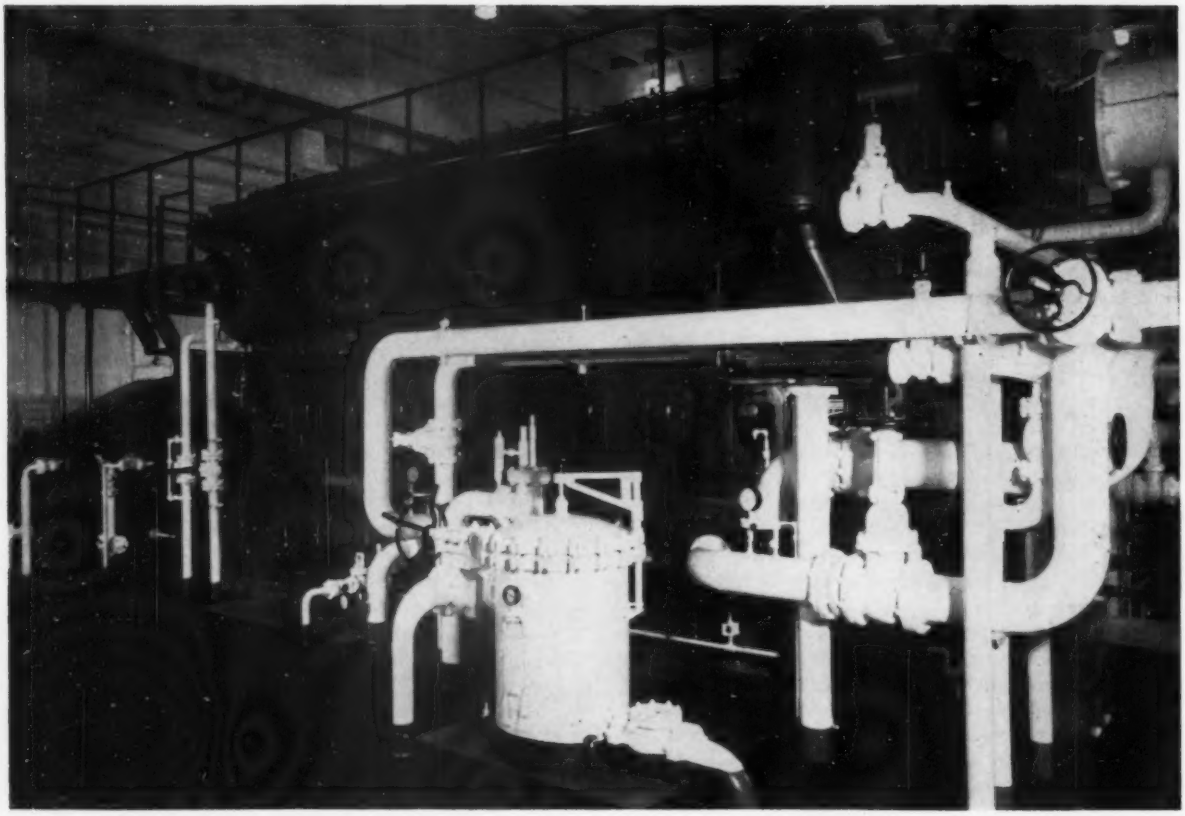
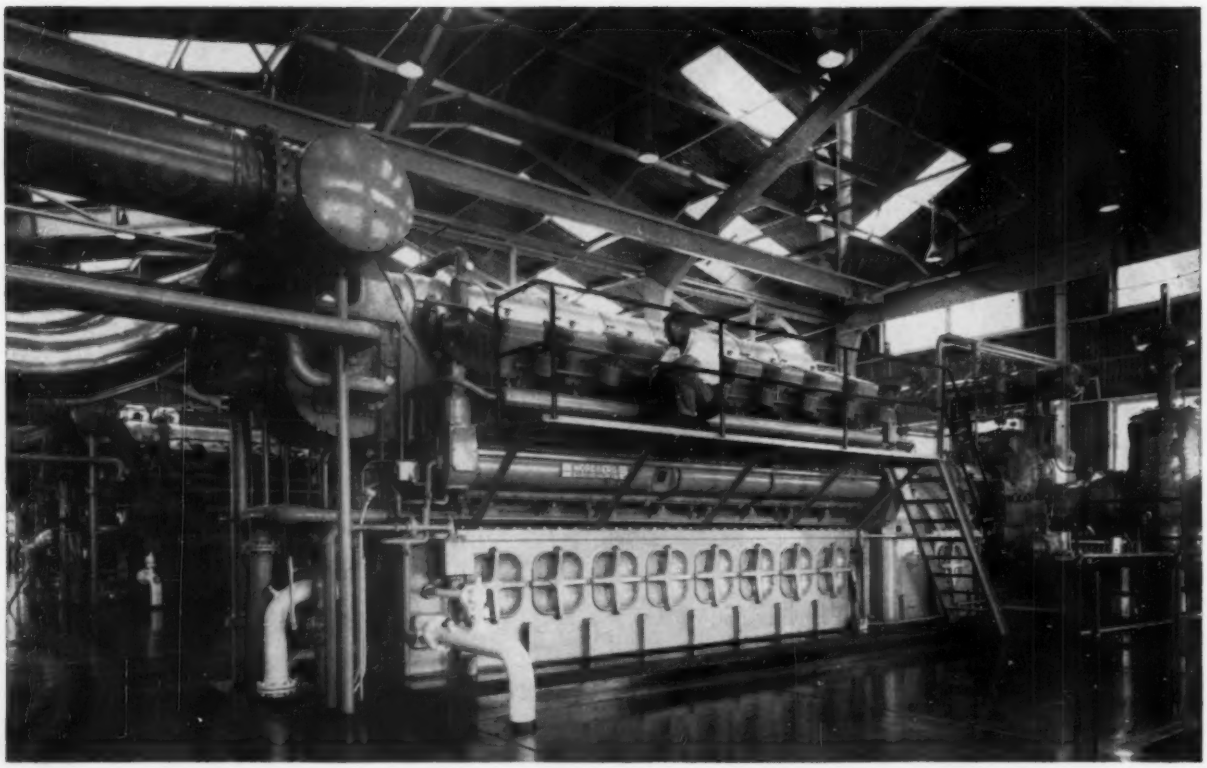


Fig. 3a. LSV unit installed on Columbia Gulf system.

Fig. 3b. Nordberg unit installed on Transco system.



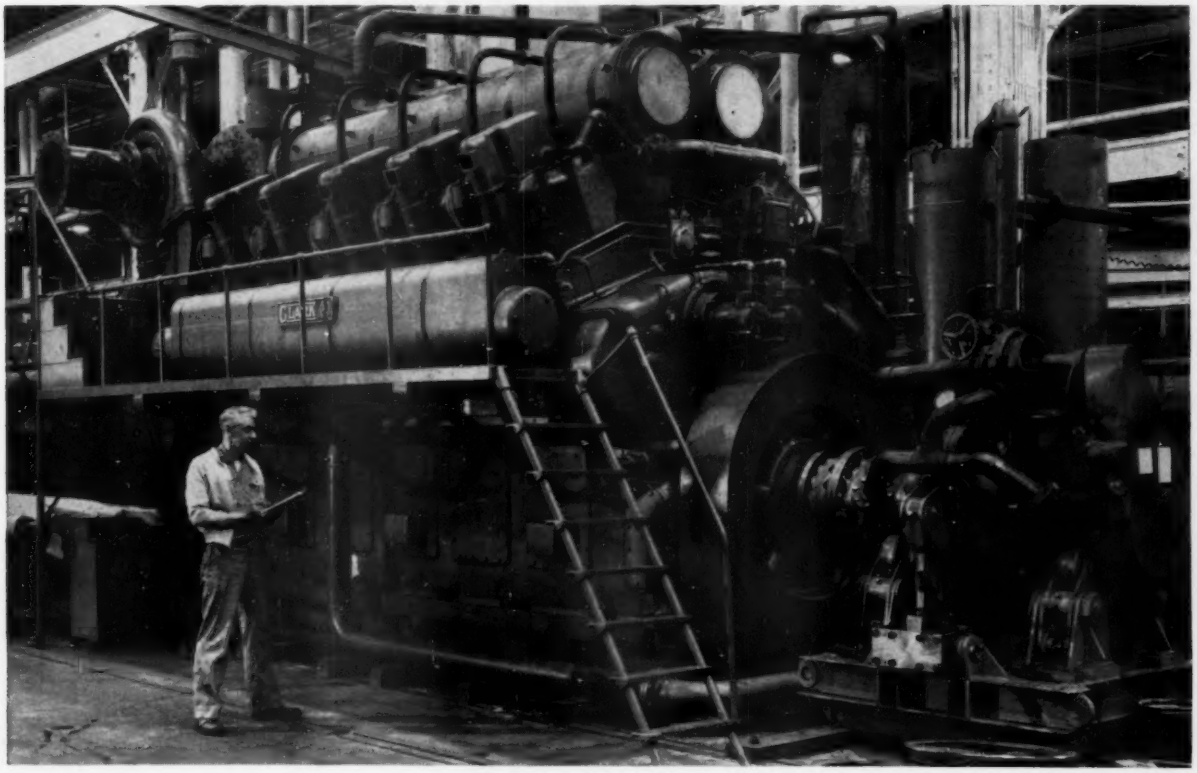
to BMEP in operating an engine, particularly in its day-by-day operation. This can be explained quite easily by remembering that up until the last few years, engine driven compressors were operated at essentially constant speed. The majority of these units were equipped with reciprocating cylinders as compressors, and were equipped with some means of unloading the unit to adjust flow.

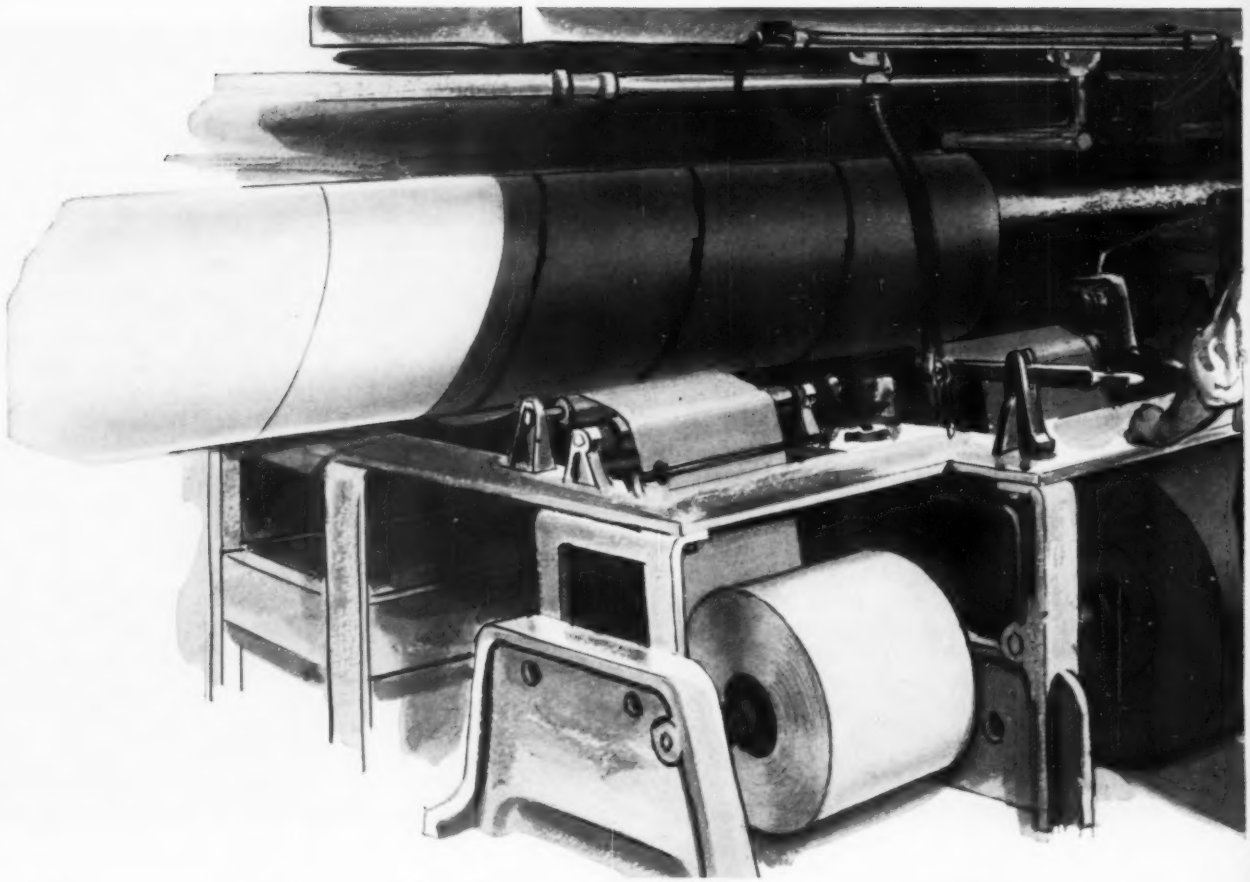
The horsepower required by the cylinders, and hence developed by the engine, varies directly with speed. Unloading cylinders and maintaining constant speed lowers the BMEP as can be seen in equation (1). The introduction of variable speed with these units must also introduce BMEP as a factor. The problem is more acute with the centrifugal since horsepower of the compressor varies with the cube of the speed and not directly as it does with the engine. The older method of operation was all right so long as the speed was fixed. As automation of compressor stations came into reality requiring variable speed for additional volume control, and as applications of variable-speed engine-driven centrifugals were made, operational troubles began to appear in the form of excessive overloading of the engines. BMEP control of engines was the answer.

In actual practice the power matching concept is applied as shown in *Fig. 9*. This figure shows a centrifugal compressor operating envelope with BMEP "factors" superimposed on the envelope. Data for this figure pertain to a Cooper-Bessemer RFB-24, centrifugal compressor, equipped with a 23-in. aerodynamic assembly. The engine driving the compressor, through a gear, is a Cooper-Bessemer LSV-16-SG. These units are installed on the Columbia Gulf pipeline. The BMEP factors are found by equating engine horsepower, expressed in terms of BMEP, to brake horsepower required by the compressor, expressed in terms of head and mass flow rate. It is usually much simpler to express the head in terms of a dimensionless ratio, the head coefficient. The "factors" so obtained are expressed in terms of flow through the compressor in standard cubic feet per day. This is shown by the simple equation in *Fig. 9*. A flow rate of 600 MMcfd has been assumed to show how engine BMEP can be obtained at any point on the envelope, once BMEP factors are plotted, by simply multiplying the factors by the flow rate. The power matching concept previously discussed has been properly employed. From *Fig. 9* is it obvious that only in the extreme upper left-hand corner of the envelope does the engine exceed a BMEP of 160 psi. The LSV engine is fully capable of round-the-clock operation at a BMEP of 160 psi, for an indefinite period. That particular engine is actually capable of producing much more power than a BMEP of 160 psi. This is, however, the operating limit that has been set for continuous duty on the Columbia Gulf system. For short periods of several hours the unit has exceeded BMEP's of 170 psi, and for test purposes up to 180 psi.

In the lower right-hand corner of the diagram, the arbitrary minimum BMEP factor plotted is 0.165 and

Fig. 3c. TPV unit on test at the factory.





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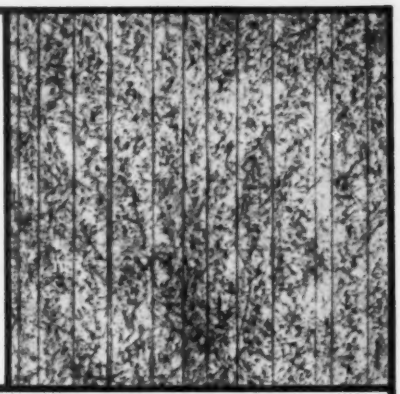

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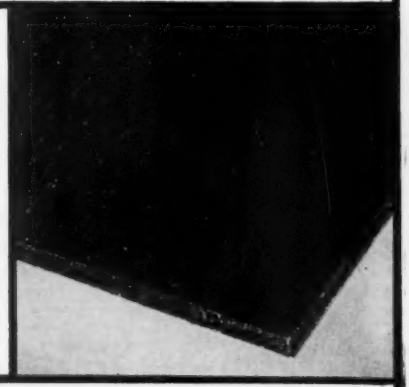

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in the example this corresponds to a BMEP of 99.0 psi. This limit was applied only for clarity of the diagram. The lower BMEP limit for the unit extends on down to about 30 psi. Thus, the operating limits for the units are from 30 to 160 psi, for a speed range (in this example) from 265 to 360 rpm. It is obvious that the matching concept has resulted in complete utilization of the compressor envelope within limits of the engine. Calculations for determining BMEP factors are somewhat long and, if all of the terms are combined into one equation, it becomes somewhat unwieldly. To simplify this problem a series of interrelated charts was designed by Gulf Interstate Co. *Fig. 10* illustrates this chart that may be used to graphically determine BMEP directly. This is, however, only one of many uses for the chart. It was basically designed to provide operating and dispatching personnel with an easy means of determining engine BMEP, from known station and compressor conditions.

The equations solved by the chart (see *Fig. 11*) are fundamental to a centrifugal compressor and the driving engine. The chart can be adapted to any centrifugal compressor by simple insertion of the proper compressor envelope in chart "C". By similarly correcting chart "F" for a different engine, the chart is easily adapted to fit other possible combinations of engine-driven centrifugal compressors. As shown in *Fig. 10*, this particular chart is designed to caculate performance of an LSV engine driving a RFB-24 centrifugal compressor, equipped with a 30-in. aerodynamic assembly. The gas is assumed to be 0.600 in gravity.

Chart "A" determines the compression ratio for a machine when suction and discharge gauge pressures are known. Chart "B" calculates the head produced by a compressor for the known suction pressure, temperature, and compression ratio as found from chart "A". Chart "C" introduces compressor speed and efficiencies into the calculations. Chart "D" calculates inlet flow to the compressor when suction gas temperature and flow rate in MMCFD are known. Thus, if the head and inlet flow to a compressor are known, the compressor speed (actually the insertion of the gear ratio allows the use of the engine speed) and efficiency are found by chart "D". Chart "E" calculates the mass flow rate of gas passing through the compressor and multiplies mass flow rate by the head. The result is known as gas horsepower.

Chart "F" adjusts the gas horsepower for compressor efficiency as found from chart "C". The proper compressor and gear mechanical efficiencies are also built into chart "F". Thus, the engine BHP is calculated in chart "F". The engine speed and BHP are also used to calculate, in chart "F", the engine BMEP. The engine BHP and BMEP are automatically adjusted to allow for power required to drive auxiliary equipment connected to the engine. An example problem is shown in the lower right hand corner of *Fig. 10* and illustrates one of the many uses of the chart. Another use for the chart is to determine lines of constant BMEP or BMEP factors as discussed in connection with *Fig. 9*.

As previously indicated the best type of operational control of an engine to prevent troubles developing

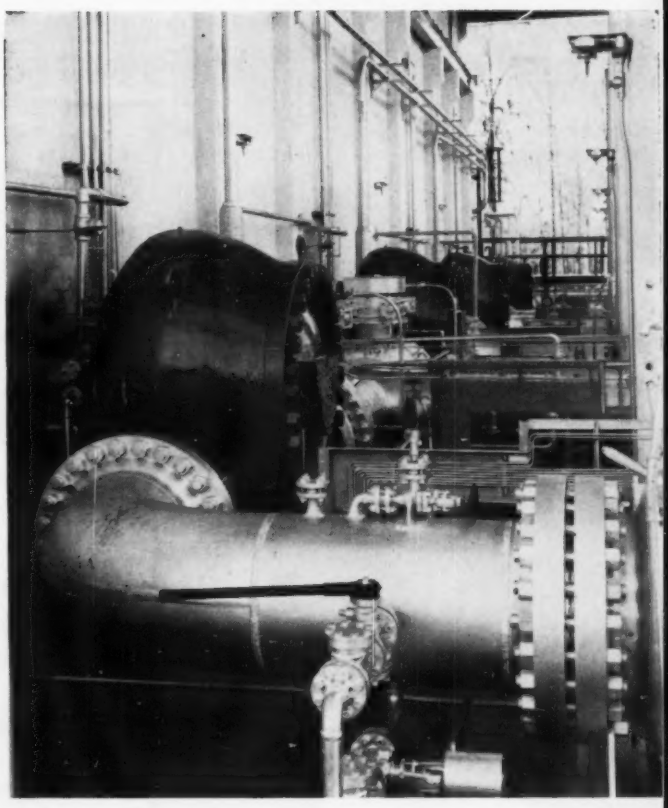


Fig. 4. Columbia's series method of using centrifugals.

from excessive overloading is through BMEP control. This type of control applies equally well to any engine, two-cycle or four-cycle, where it is operated with variable speed. The problem is more acute with an engine driving a centrifugal compressor than it is with reciprocating compressors. This problem was successfully handled several years ago by the former Gulf Interstate Gas Co. The chart in *Fig. 10* and a similar chart, for both makes of two-cycle engine-driving reciprocating cylinders on that pipeline, provided necessary tools to achieve effective operational control of engines in terms of BMEP. Today, that pipeline is not only operated in terms of BMEP, but it is also dispatched in terms of BMEP.

BMEP charts are handled by the dispatchers in the centralized dispatching office. Since that pipeline is remotely and automatically controlled from that office, actual control of engines is in the head of the dispatcher, not in the stations. It is therefore the dispatcher's responsibility to continuously monitor the BMEP actually being developed by each and every engine on the line, exactly the same as horsepower is monitored on other pipelines. This requires him to constantly refer to BMEP charts. In the case of reciprocating compressor this does not require much effort. In the case of centrifugal compressors this is a different story.

There are on that pipeline, 20 engine-driven centrifugal units. There are four units in series at each of

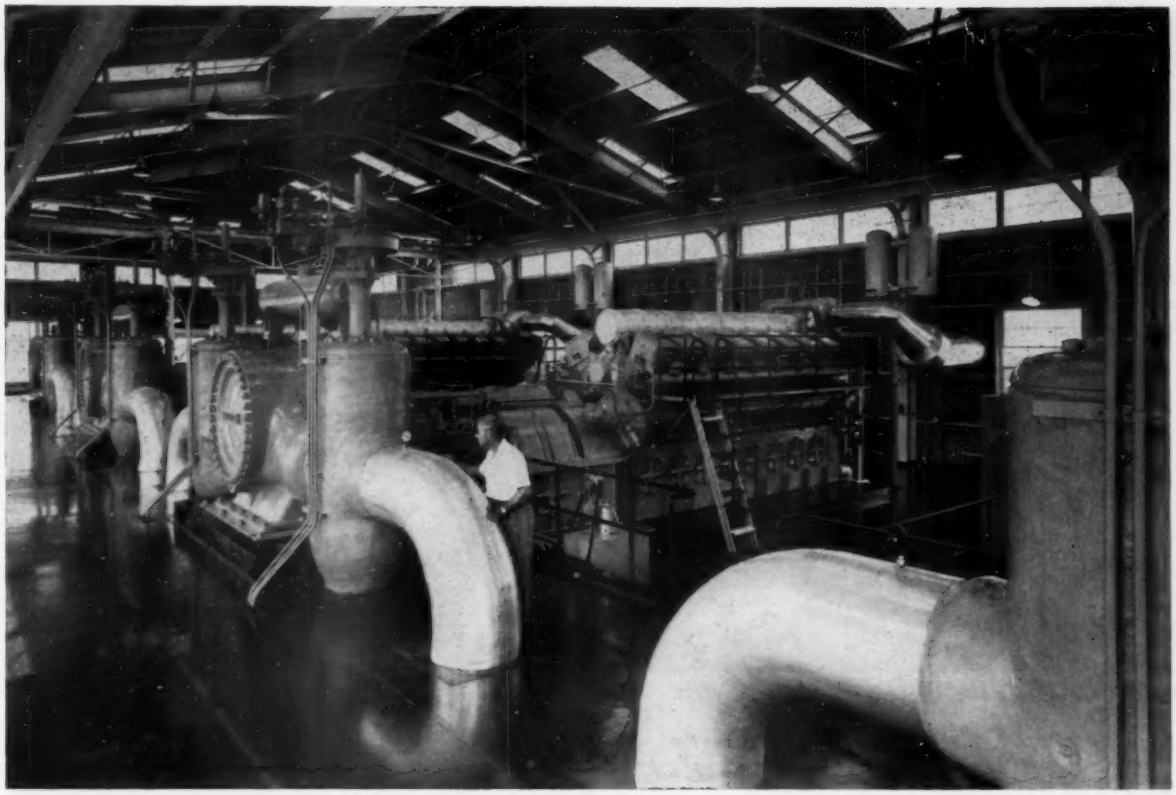


Fig. 5. Series method of employing centrifugals on Transco system.

five stations. The chart is *Fig. 10* calculates BMEP for each unit. But it requires more than a few minutes to follow through on the chart.

The chart cannot predict inter-stage conditions. These conditions must be known before the chart can be used. Since these calculations are required at least every hour, this becomes something of a chore. The problem was recognized several years ago when the BMEP operational control program was instituted. Columbia Gulf, in cooperation with Computers, Inc. (Houston), designed an analog computer to compute BMEP of each engine at centrifugal stations. The method of calculation employed in the computer is the same as that graphically calculated by the chart in *Fig. 10*—with the exception that it computes in series the interstage conditions for each compressor, beginning with the first suction unit. *Fig. 12* shows the computer, which we call a "compressor simulator." This unit is installed at the centralized dispatching office, and is used by dispatchers so that they may properly dispatch centrifugal units in terms of BMEP. The computer is designed to solve other types of dispatching problems connected with operating speeds, pressures, etc., of engine driven centrifugal compressor units.

Operational use of BMEP extends into each compressor station. At centrifugal stations, BMEP is correlated with pressure in the air manifold header of the engine. In *Fig. 13* the relationship of air manifold pressure with BMEP and speed is shown. This chart has been widely tested for the past several years and it is accepted by operating personnel as an excellent parameter of the LSV engine performance. Air manifold pressure is widely accepted in the air craft and automotive fields as an index to an engine's performance. This parameter is especially true in the case of the LSV engine. The engine controls, such as ignition timing, valve tappet settings, turbocooler, and turbocharger, etc., are all evaluated and adjusted in terms of air manifold pressure.

However, this pressure varies with speed and BMEP. *Fig. 13* displays this relationship. Experience proves that when an engine is in good condition and the air manifold pressure is adjusted to the value indicated by the chart, the engine will develop its best performance and will be operating at is minimum fuel consumption. The excellent fuel consumption and performance of this engine on the Columbia Gulf pipeline is a direct result of the use of this chart. Inability of an engine to operate at the required air manifold pressure is a sure indicator that trouble has developed or is developing with some components. This is usually the first sign of a component malfunction. Thus, the trouble can usually be isolated while the engine is operating and a planned shutdown scheduled instead of allowing the trouble to reach such proportions as to necessitate an emergency shutdown.

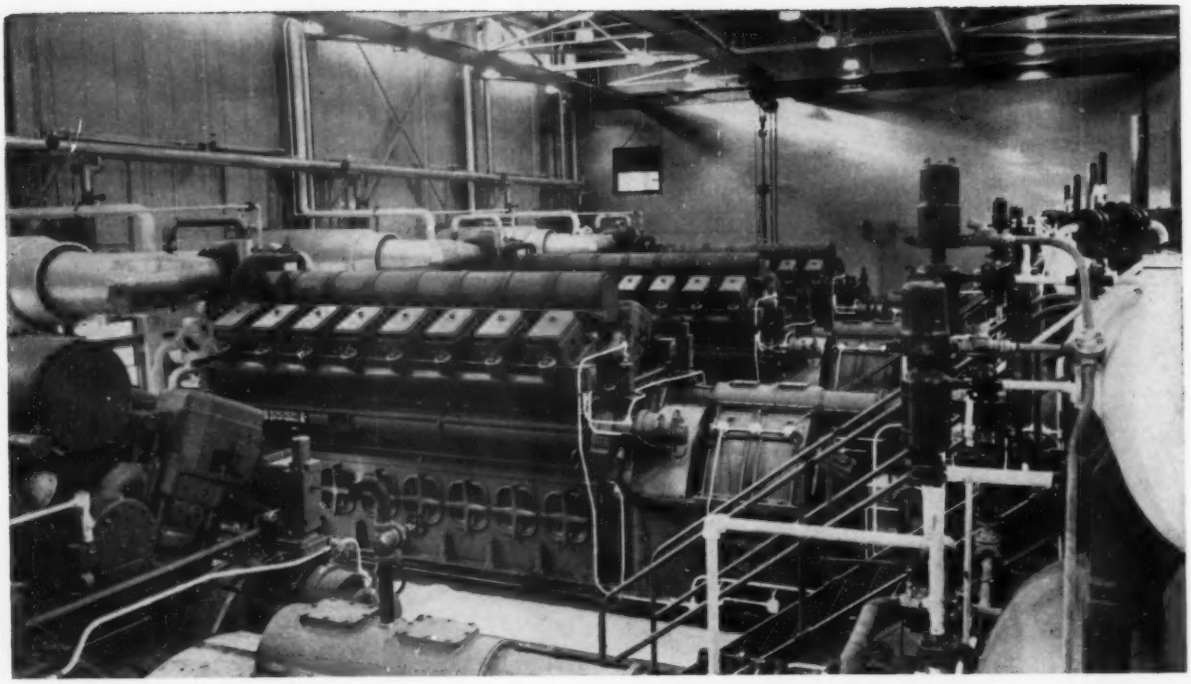


Fig. 6. Gear set used with Nordberg engines.

Fig. 7. Close-up of gear set used with Cooper-Bessemer engine.

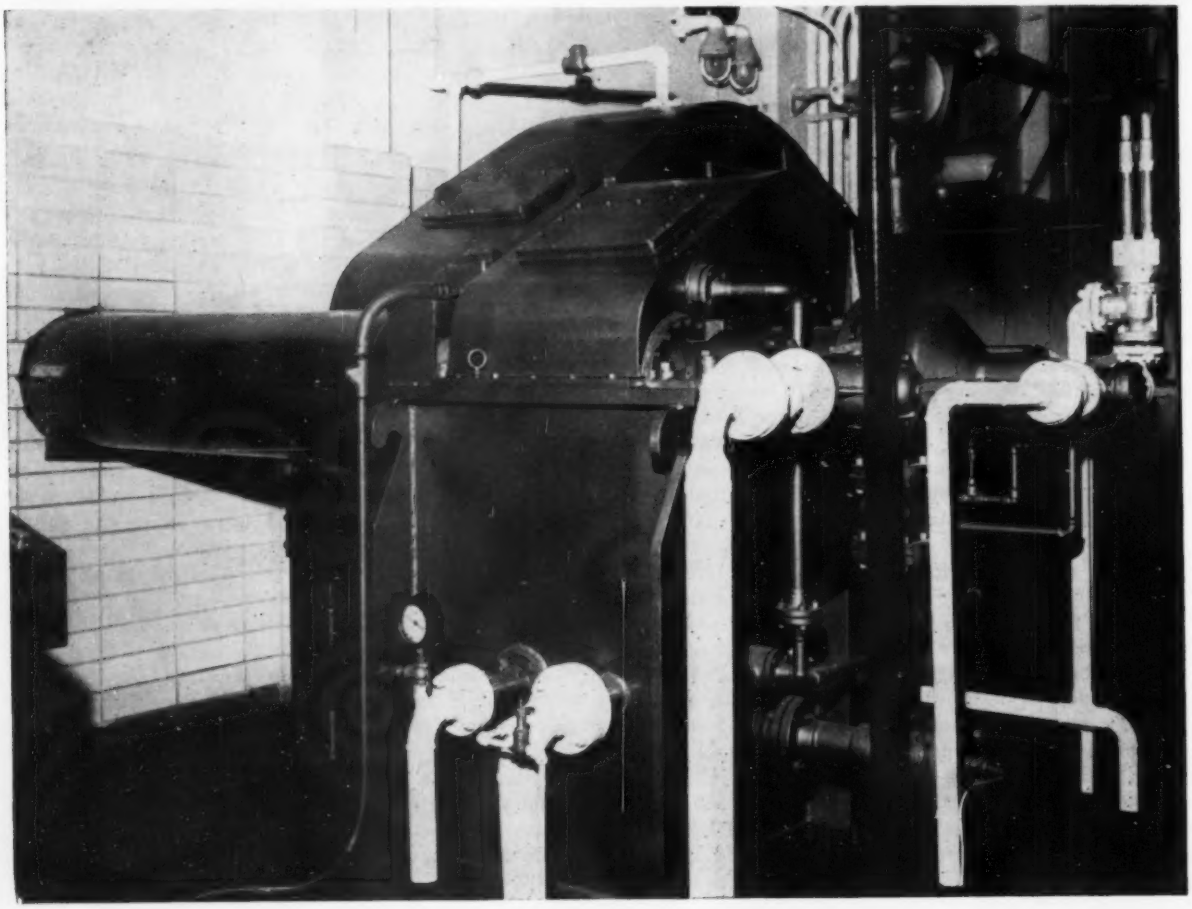
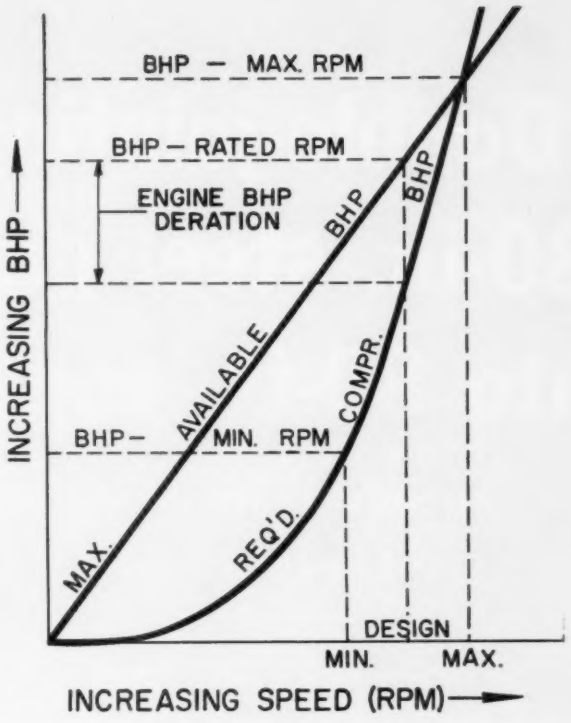


Fig. 8. Brake horsepower mismatch of centrifugal compressor with reciprocating engine prime mover.



The excellent record of continuous operation of the Columbia Gulf units is testimony to the suitability of the engine-driven centrifugal compressor to automatic operation. These units have been on automatic, remote control since the early part of 1957. The units are completely unattended and are operated remotely from the central dispatching office. The dispatcher has the ability to set the desired discharge pressure of the station. The automatic controls at the station actually control the speed of the units to produce the desired discharge pressure.

If the discharge pressure cannot be produced, the dispatcher is automatically notified so that he can remotely start another engine. The dispatcher only initiates the starting sequence. Once initiated, the automatic controls at the station start the selected unit, allow it to warm up and then load the unit. Because the four centrifugal units at each station are in series, heads produced are additive. Thus, a readjustment of speeds at which the other units are operating may be necessary. If so, the adjustment is automatically made and the speed of each unit operating is adjusted so that the combined heads produce the required station discharge pressure.

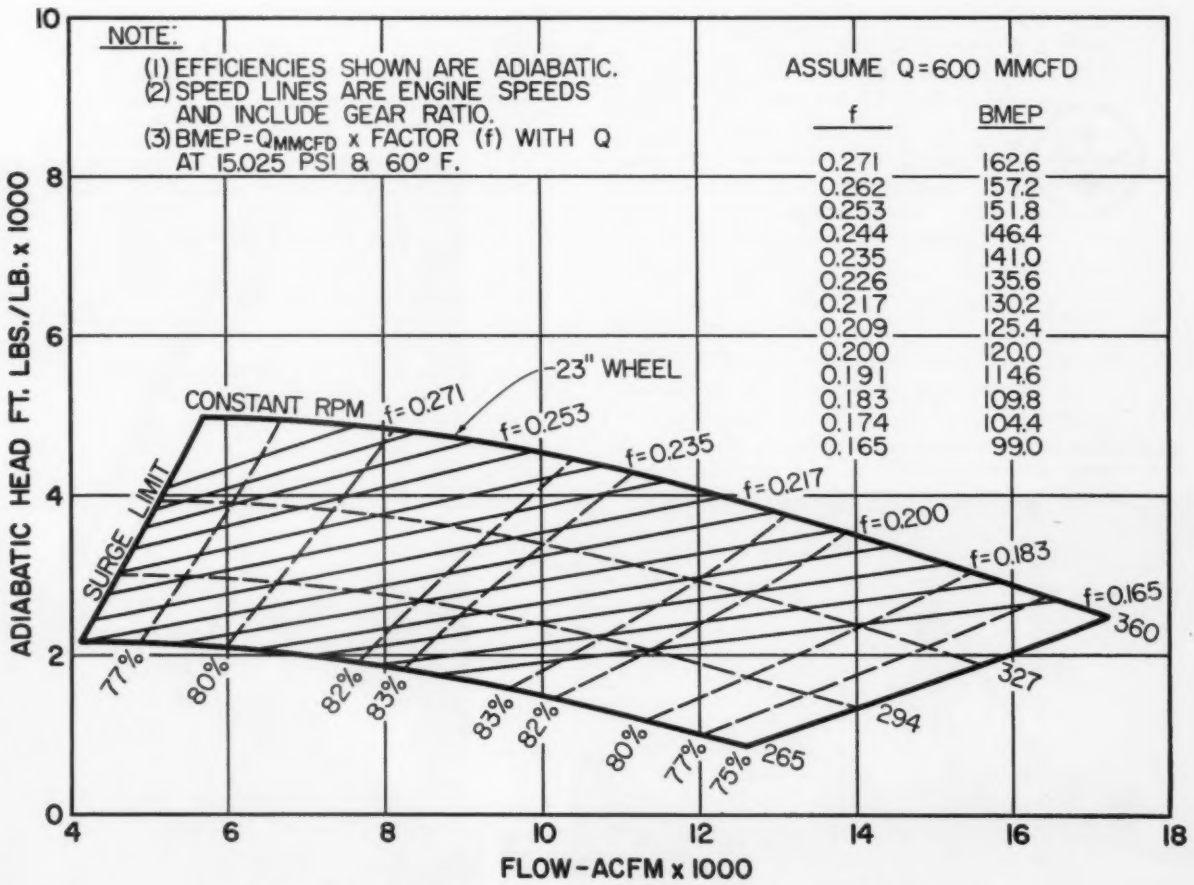


Fig. 9. Proper matching of engine and centrifugal compressor characteristics.

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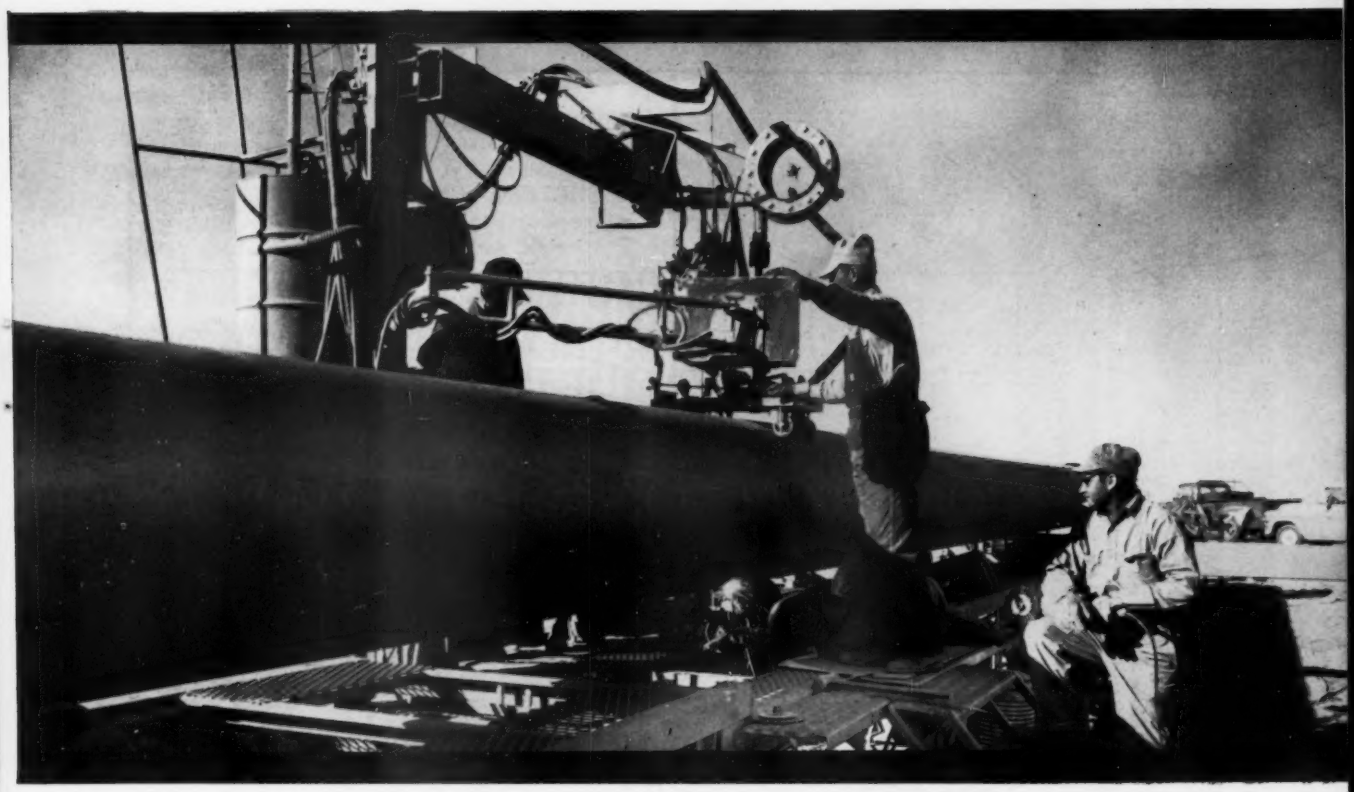
It was plenty cold west of Roswell as the coating and wrapping crews "did their stuff."



Transwestern Pipe Line Company's "big inch" from West Texas to the Arizona-California border is a big job with a big objective —to deliver 300 million cu ft of natural gas per day to Southern California utilities. This calls for the construction of gathering systems and laterals in the Permain Basin of Texas, and in the Panhandle fields. And it requires laying main line of 30 in. OD pipe from Roswell, New Mexico, clear to the California-Arizona border.

Double-jointing in the field

There's plenty of Bethlehem Line Pipe on the job, including the entire distance between Compressor Stations Eight and Nine west of Roswell. On this spread Houston Contracting Company used a new technique—double-jointing the pipe in a yard with special pipe handling and automatic welding equipment. The 80-ft joints mean more footage per truckload, cutting both delivery time and costs. It also resulted in excellent, low-cost welds, with a corresponding reduction in the number of slower, costlier field welds.

Gulf Interstate Company is handling a major portion of the engineering and design of the Transwestern project.

You'll find Bethlehem Line Pipe in all diameters on spreads throughout the land. It's good pipe, made to the highest standards on mills that rank with the finest. We'd be happy to give you more information. Just contact the Bethlehem sales office nearest you.

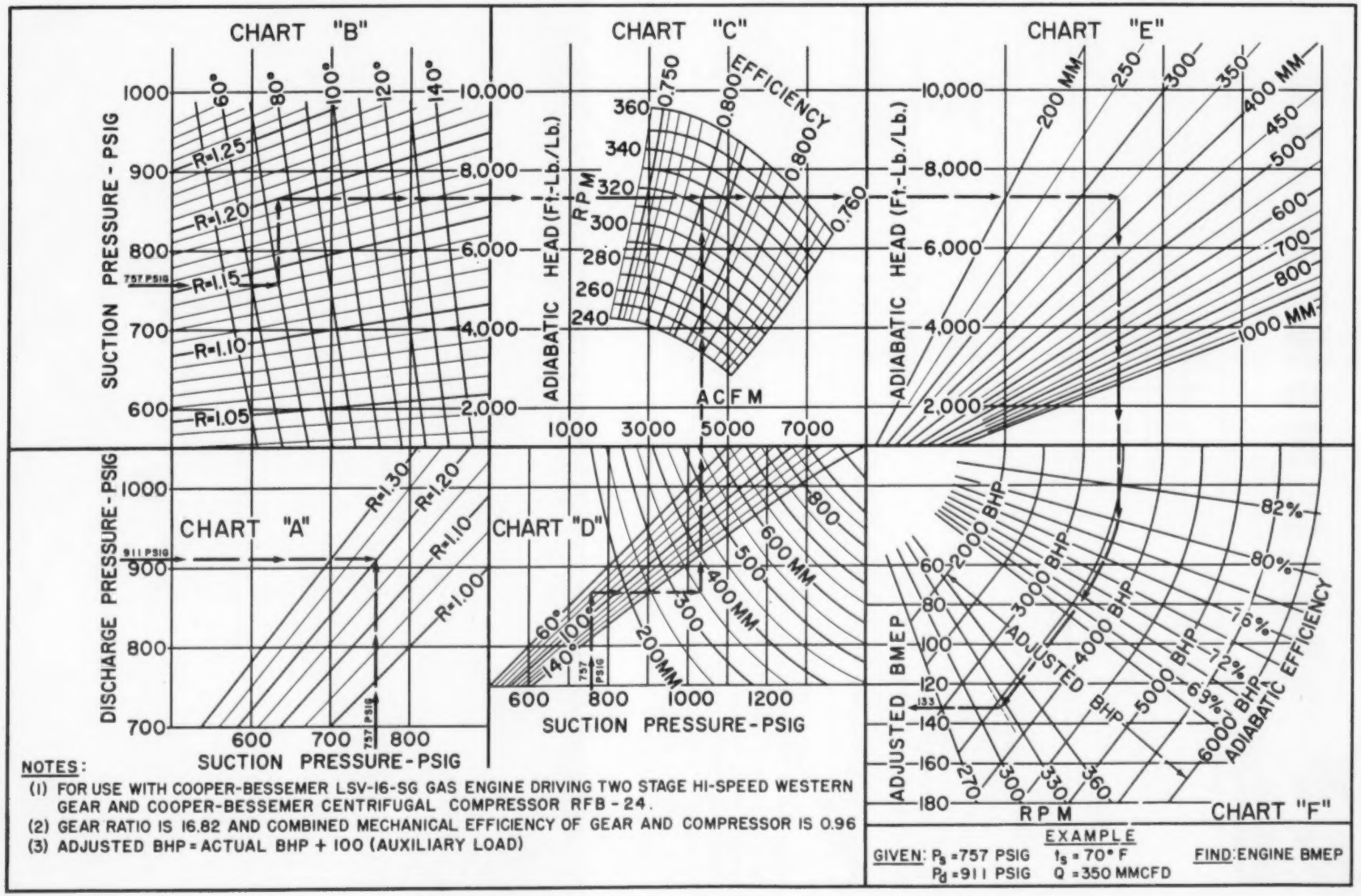
NOW AVAILABLE IN ALL SIZES MEETING API SPECIFICATIONS

	SIZES (in., OD, incl.)	WALL THICKNESS (in.)	LENGTHS	SPECIFICATIONS
HYDRAULICALLY EXPANDED ELECTRIC FUSION-WELD (submerged arc)	18 to 42	¼ to ¾ incl.	40 ft	API 5LX, Grades X42, X46 & X52 Also X-56
ELECTRIC RESISTANCE-WELD	5⅝ to 16	API	to 60 ft	API 5L, Grades A & B API 5LX, Grades X42 & X46
CONTINUOUS BUTTWELD	½ to 4½	API	SRL 24 to 26 ft DRL to 50 ft	API 5L

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



NOTES:

(1) FOR USE WITH COOPER-BESSEMER LSV-16-SG GAS ENGINE DRIVING TWO STAGE HI-SPEED WESTERN GEAR AND COOPER-BESSEMER CENTRIFUGAL COMPRESSOR RFB-24.

(2) GEAR RATIO IS 16.82 AND COMBINED MECHANICAL EFFICIENCY OF GEAR AND COMPRESSOR IS 0.96

(3) ADJUSTED BHP = ACTUAL BHP + 100 (AUXILIARY LOAD)

EXAMPLE

GIVEN: P_s = 757 PSIG t_s = 70° F FIND: ENGINE BMEP

P_d = 911 PSIG Q = 350 MMCFD

Fig. 10. Interrelated charts may be used to graphically determine BMEP directly.

The adaptability of the engine-driven centrifugal-compressor units to automation is only one of the many features of this combination. Maintenance of the combination is another. The centrifugal compressor normally requires very little maintenance, so long as an adequate supply of clean oil is maintained to the bearings and to the high pressure seals. In general, the four-cycle engine requires little attention once it has been properly adjusted.

The experience with the Columbia Gulf units indicated that those units require little maintenance outside of occasional replacement of a spark plug or an ignition wire, etc., all minor items. An annual overhaul period of 12,000 hours or more allows the operating group to plan the overhaul of individual units so that it occurs during months of reduced flows.

The excellent operation records compiled during the last three years by the engine-driven centrifugal compressors is ample recommendation to the industry as to the desirability, reliability and economical operation of the combination. ■

This article is adapted from a talk presented at a recent meeting of the California Natural Gasoline Association.

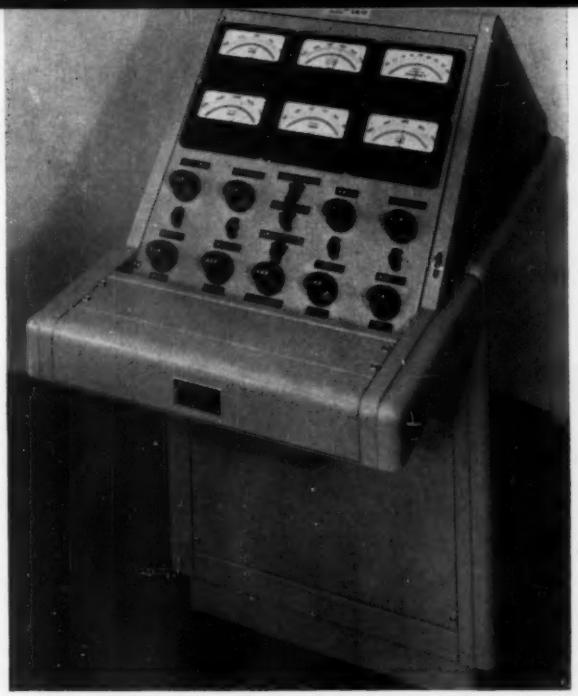


Fig. 12. Compressor simulator computer.

INLET FLOW (ACFM)

$$Q_{IN.} = \frac{Q_{STD.} \times P_b \times T_{IN.} \times Z_{IN.}}{1440 \times T_b \times P_{IN.}}$$

ADIABATIC HEAD (Ft.-Lb./Lb.)

$$Hd = \frac{R \times T_{IN.} \times Z_{AVG.} \times \left(\left(\frac{P_2}{P_1}\right)^{\frac{K-1}{K}} - 1\right)}{\left(\frac{K-1}{K}\right)}$$

POLYTROPIC EFFICIENCY

$$EFF._{POLY.} = \frac{\frac{K-1}{K}}{\frac{n-1}{n}}$$

MASS FLOW (Lb./Min.)

$$m = \frac{Q_{STD.} \times Sp.\,Gr. \times M_{AIR}}{1440 \times Mv_{AIR}}$$

ADIABATIC GAS HORSEPOWER

$$GHP_{AD.} = \frac{Hd._{AD} \times Mass\ Flow}{33{,}000}$$

ADIABATIC TEMP. RISE EFFICIENCY

$$EFF._{AD.} = \frac{\Delta T_{AD.}}{\Delta T_{ACT.}} = \frac{T_{2AD.} - T_1}{T_{2ACT.} - T_1}$$

Fig. 11. Summary of equations, centrifugal compressors.

$$M_{AIR} = 29 \frac{Lb.}{MOL}$$

$$Mv_{AIR} = 371 \frac{Ft^3}{MOL}$$

SHAFT HORSEPOWER

$$S.HP = \frac{GHP_{AD.}}{n_{AD.} \times n_{MECH.\,COMP.}}$$

PRESSURE AND TEMP. RELATIONSHIP

$$\left(\frac{P_2}{P_1}\right)^{\left(\frac{n-1}{n}\right)} = \frac{T_2}{T_1}$$

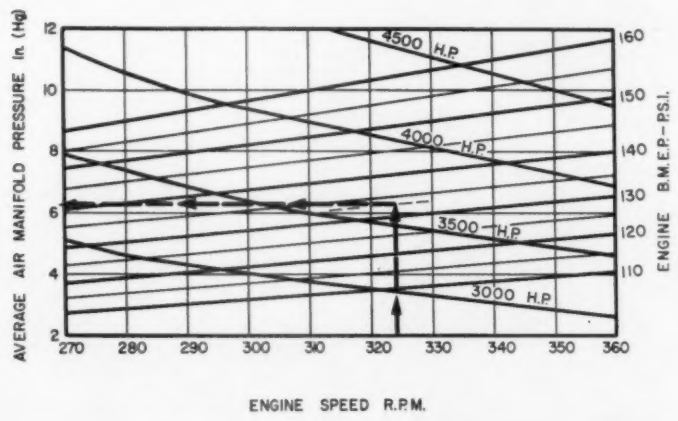
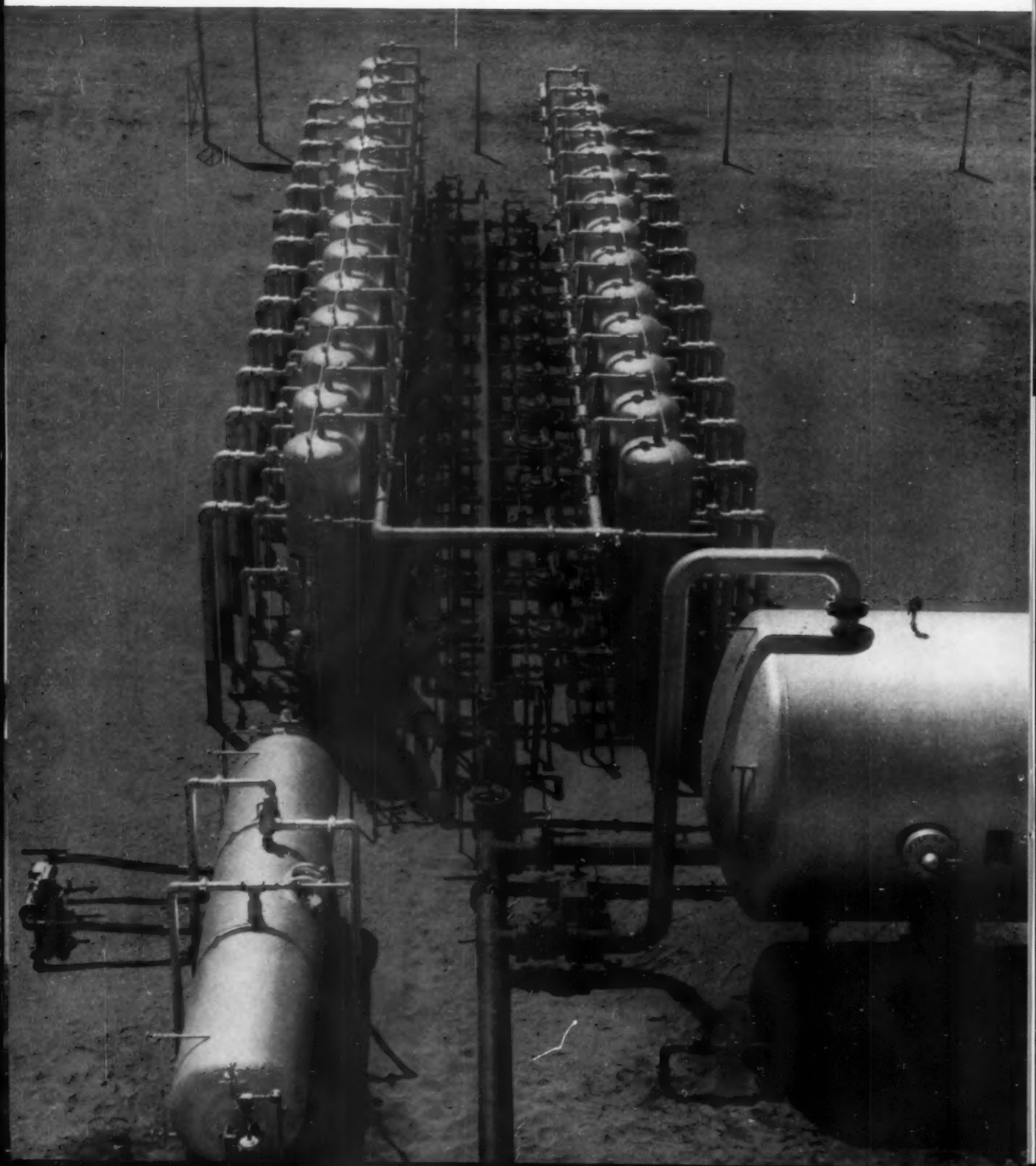


Fig. 13. Air manifold pressure vs. engine BMEP.

automatic – economical
it's Foxboro Gas-Oil



– maintenance-free...
Separator Control

Three simple, low-maintenance Foxboro instruments — that's all you need in Foxboro's automatic oil-gas separator control system.

1. The Foxboro d/p cell* controller to regulate tank level and, where desired, provide automatic emergency shut-off of incoming production
2. The Foxboro M/41A Controller to maintain constant, even back-pressure in the separator
3. The Foxboro T/37 Diaphragm Meter for accurate indicating measurement of gas flow leaving the separator

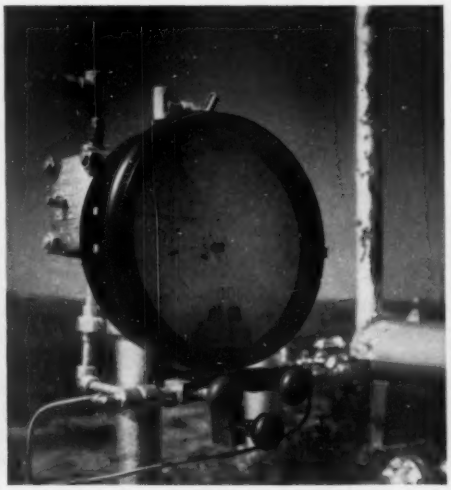
Three, simple, low-cost, low-maintenance instruments to control the whole separation process — economically, automatically.

Ideal for a single separator, or for a whole battery of them. Ask your nearby Foxboro Field Engineer for details. Or write for Bulletin 1-28.

The Foxboro Company, 346 Norfolk Street, Foxboro, Massachusetts.

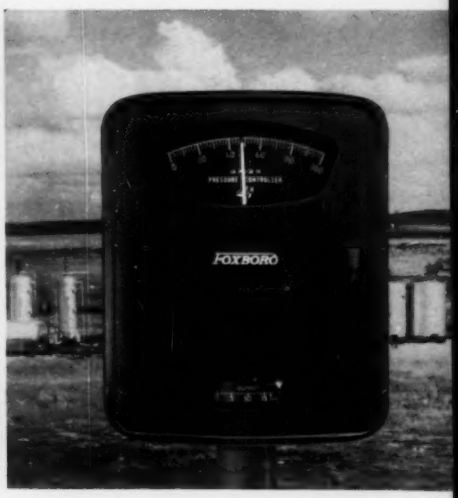
For Oil Level Control...

d/p cell measures change in separator level and operates Foxboro control valve in oil draw-off line. When valve is equipped with Foxboro Valvactor* positioner oil in separator can be controlled through any desired range of level.



For Gas Flow Measurement...

the Foxboro T/37 Diaphragm Meter. Keeps accurate chart record of gas flow leaving separator. Meter uses no mercury — cannot be damaged by overrange. Simple, rugged, responsive — it seldom requires maintenance of any type.



For Back-Pressure Control...

the Foxboro M/41A indicating controller. Maintains close control of pressure in separator by operating Foxboro Stabilflo* control valve in output line. Smooth, even gas flow is assured. Separator back-pressure may be easily preset from index pointer on controller.

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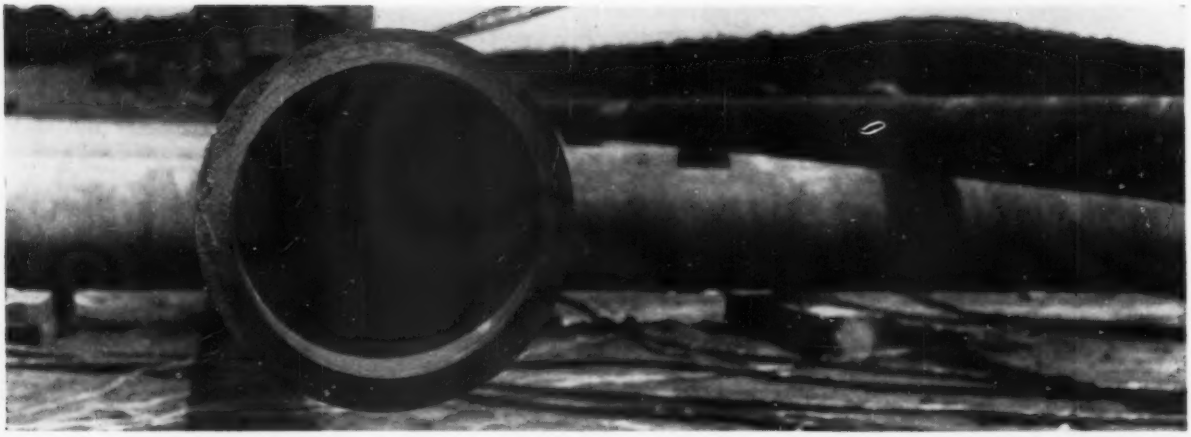
Pipeline evolution



from crude logs to 5000 psi systems

By FLOYD TRILLIS, Engineer
New York State Natural Gas Corp., Pittsburgh

STORAGE of natural gas in depleted gas reservoirs is one of the significant developments recorded by the gas industry in recent years.

One such reservoir is the Leidy field in north central Pennsylvania. This field had its beginning in 1950. The first well had an open flow of 15 MMcfd with a rock pressure of 4200 lb. Others followed, some being of greater magnitude. The Finnefrock well drilled by New York State Natural Gas Corp. blew in at 145 MMcfd, making it the highest volume east of the Mississippi.

New York Natural produced and purchased most of the gas from this prolific field and held leases for the greater portion of the acreage. By 1955, production had depleted the pool significantly, and conversion of the field to storage was given serious consideration. For various economic reasons, we decided to use the reservoir to its optimum capacity, i.e., original rock pressure.

This would require surface injection pressures approaching 5000 lb, making it unique among storage installations. It could very well be the nation's most significant and highest pressure storage area.

An important part of this storage area is the network of pipelines serving the wells within the pool. The first stage in the development of this 5000-psi pipeline injection system was construction of 13 miles of 12-in. pipe extending the length of the storage pool. Also involved: 22.5 miles of 10-, 8-, and 6-in. laterals serving the 85 wells within the pool.

This system unquestionably is another milestone in the transit of natural gas. It differs markedly from the conventional pipelines of today. Certainly it is a far cry from the crude log pipelines of bygone days.

The first natural gas pipeline of any significance was built in 1872 between the gas fields in West

ABOVE: Thirteen miles of this high-pressure pipe is used for injection and withdrawal at Leidy. The 12-in. line has a wall thickness of 1.312 in.

Bloomfield, N. Y., and the city of Rochester, a distance of 25 miles.

Coincidentally, a close parallel exists in the dimensions of the piping employed on these two systems. The main trunkline on the Leidy project consists of 12¾-in. OD, 1.312 wall pipe. The earlier line was built of white pine logs about 12½ in. in diameter and hollowed out leaving a wall of approximately 2 in. These logs varied from 2 to 8 ft in length and were connected by ball and spigot joints.

Certain construction problems were foreseen because of this departure from tradition. Most of these proved worthy of consideration, some to a greater degree than others. Some problems arose that were not anticipated. A brief report such as this cannot tell all there is to be told, but we will try to cover the most significant phases.

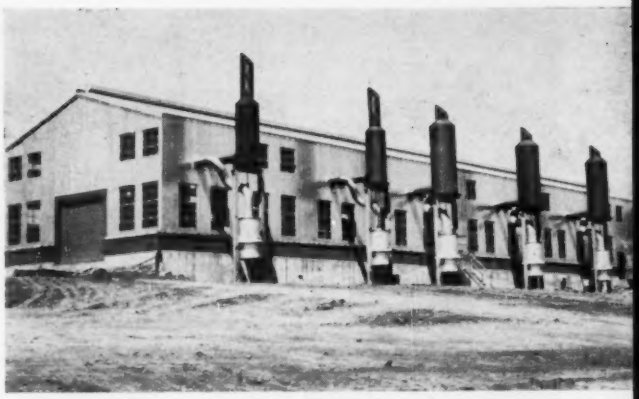
The critical pressures justified a thorough study of materials. Safety and economic considerations are generally the criteria for basic design. Necessary stress levels are mathematically determined by using certain materials and predetermined design factors. Safety factors based on tensile strength vary with the material for any given conditions, so the material specification becomes an important consideration.

One of our first approaches was material correlation. Questionnaires were sent to various parties involved in operations of this nature and size. We found that 4- and 6-in. lines were being used in the Southwest in cyclic activities. Also that small amounts of larger pipe were being used in compressor station and process work. Lower yield strength material had been used exclusively in these installations and was highly recommended for this particular project.

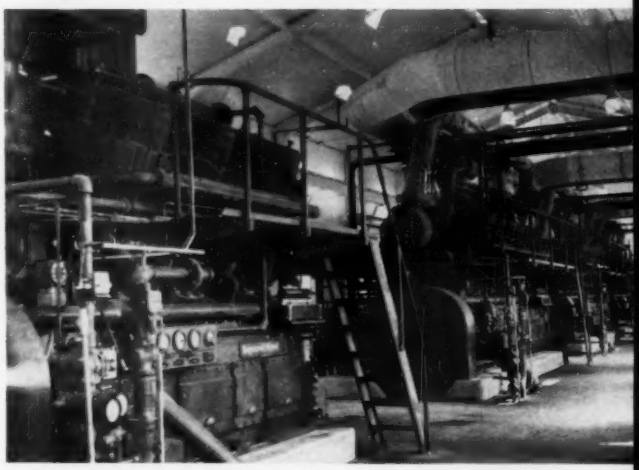
In the past decade, certain new materials were introduced employing higher working stresses. They were also more economical to use. Naturally, they deserved some serious consideration. Therefore, we investigated these materials to assess their applicability to this service. Certain limitations required attention. Using these materials inadvertently meant lower safety factors since the yield strength became a greater percentage of the tensile strength. Also, these newer materials were generally accompanied with lower ductilities and higher notch sensitivities —to a degree not well defined—than the time-honored lower yield strength materials.

Naturally, the question arose as to whether these limitations were justified by the use of more exacting design, fabrication and inspection practices. This was not aptly defined by the evidence at hand. Heretofore an accurate assessment of the loading conditions on underground pipeline systems was not readily available. As for the new materials, their behavior under the various service conditions was not too generally known. These uncertainties left much to be desired. Thus for structural soundness it was advisable to employ the lower yield strength materials assuring less susceptibility to failure.

By virtue of the 5000-psi pressure rating involving heavier walls and greater thickness/diameter ratios, the piping design took on a different aspect because we had to consider both membrane stress formulae and thick wall formula.



Compressor building houses three 2000-hp engines and two 1000-hp engines. As engines are added to meet increased demands, the building will be lengthened toward the left.



Interior of compressor building during break-in period. Three 2000-hp engines are in the background, one of the two-1000-hp engines is in foreground.

Double-jointing equipment used submerged arc fusion.

Building a "perfect 36" from Joliet to Chicago

60-mile line of The Peoples Gas Light and Coke Company and Chicago District Pipeline Company spans congested area —under rivers, streets and railroads with minimum disturbance and maximum protection to populace

It was business as usual during construction of the third Calumet Line — a 36-inch pipe that will ultimately deliver 557 million cubic feet of natural gas per day to the Chicago area. Although the line crossed 77 roadways, 25 railroads and six principal streams, careful planning kept road, rail, barge and ship traffic flowing smoothly.

A. O. Smith supplied 20,000 tons of the largest standardized steel pipe available. The choice was natural. For over 30 years . . . A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe is found in so many important pipeline projects.

Through research A.O. Smith *. . . a better way*

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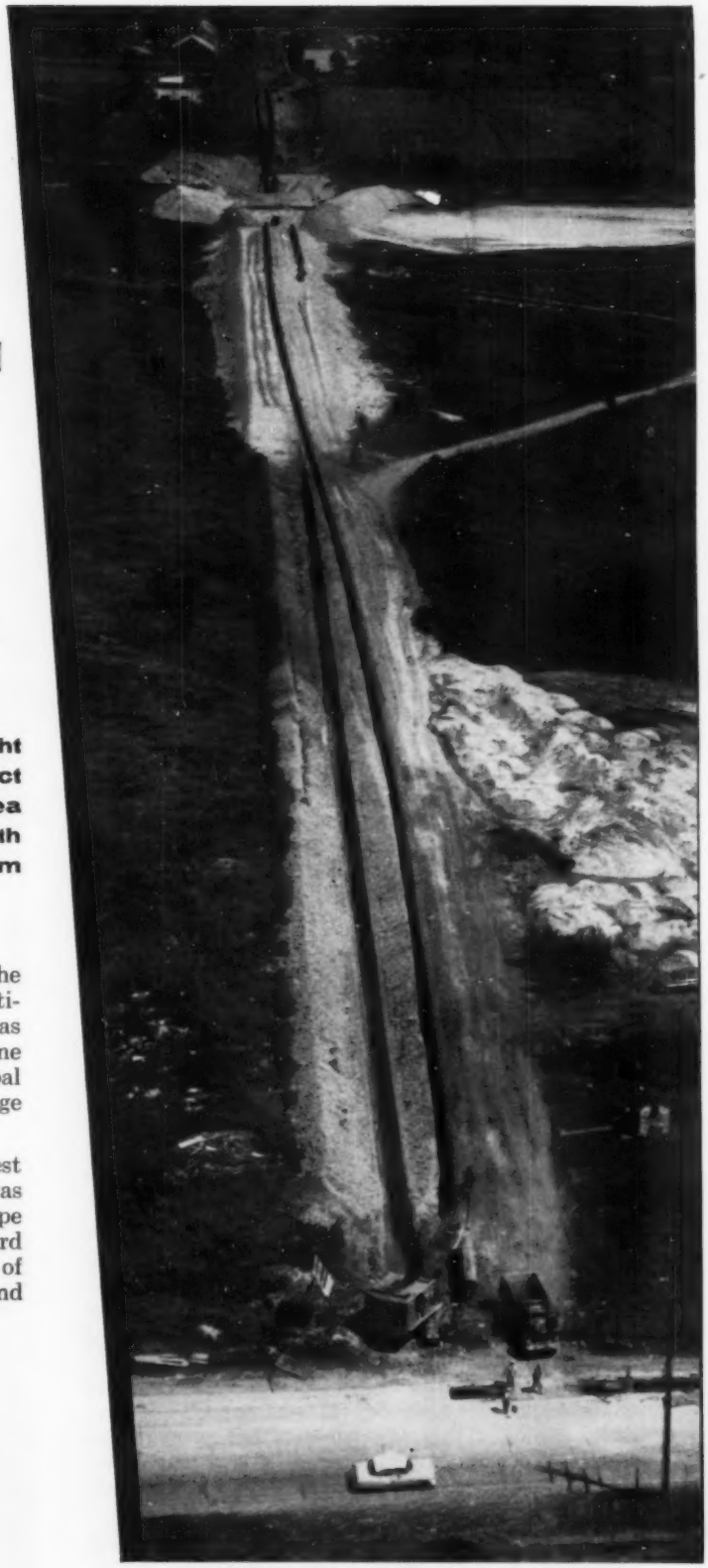


ROADS — Pipe tunneled under 77 roadways. Special steel plates were used to cover trench to keep streets, driveways and parkways open. In residential areas, special rubber-tired equipment kept down noise . . . mechanical sweepers kept down dust.

RAILWAYS — Line crossed 73 tracks of 17 railroad companies. Here workmen are installing steel casing for the line under the Atchison, Topeka & Santa Fe and The Gulf Mobile & Ohio tracks south of Joliet.

STREAMS — Line dives under the Calumet River on Chicago's south side. Tunnel is 687 feet long. Top of the tunnel is 60 feet below the surface. One of six river crossings constructed on the third Calumet Line.

Therefore, in establishing the wall thicknesses, several of the most commonly used formulae were studied. These formulae yield results of great similarity. So on this basis, the Transmission Formula was chosen for wall determinations.

The suitability of the Gas Transmission Code to these operating conditions was also questioned and the matter submitted to the A.S.A. B31 Sectional Committee. The Gas Transmission Code was termed adequate to this job and we decided to apply the Code in its entirety.

The design, fabrication—both factory and field—and inspection specifications were proportioned to the materials selected and the intended service. Some of the fabrication problems were quite interesting. In certain cases they were a matter between New York Natural and the manufacturers and contractor, depending on the nature of the work.

As a case in point, preliminary investigations showed that there would be some difficulties in joint line-up preparatory to welding. For example, the heavy walls made it necessary to revert to external pipe clamps because it was impractical to devise an internal clamp with enough force to be effective, i.e., form the end of the pipe into a perfect round.

It is common knowledge that a concentric ID-OD pattern at the weld ends in most cases is not achieved effectively in manufacturing. Therefore, as a further aid to pipe alignment we decided to true-up the internal diameter with respect to the outside diameter at each end.

Accordingly, each joint of pipe was furnished with a special end preparation at the mill, as shown by the internal taper on *Fig. 1*. This afforded a more accurate and faster line-up in the field with the use of external clamps. These advantages more than offset the premium paid for this specified requirement.

In spite of these innovations, line-up was fairly difficult. Line-ups on welds involving fittings were very difficult as were those involving pipe that was field cut and beveled, wherein it was impractical to reproduce the internal bevel.

The pipe was all supplied by the manufacturer to API-5L Grade B Specifications. It was the largest order placed at that company for heavy wall pipe by a single customer. This pipe, all seamless, was designed for 5000-psig working pressure, according to ASA B31.1.8-1955, Class A. construction. The pipe requirements were as follows:

13 miles of 12-in. x 1.312 wall; 1 mile of 10-in. x 1.25 wall;

2 miles of 8-in. x .906 wall; 19.5 miles of 6-in. x .718 wall.

The 13 miles of 12-in. pipe were supplied mostly in 22- to 35-ft lengths, the joints averaging about 33 ft.

It is common practice in pipeline construction to determine the procedures and equipment according to the pipe size, wall thicknesses being of secondary importance. A deviation from these conditions led us to depart from traditional procedures.

The field assembly and installation of the pipe on this project differed somewhat from the conventional manner. This was because of the heavy walls and of a greater consequence than indicated by the size of the pipe. This is best illustrated by the fact that although the piping was 12 in. and under, we had to use equipment normally required for a 30-in. pipeline project.

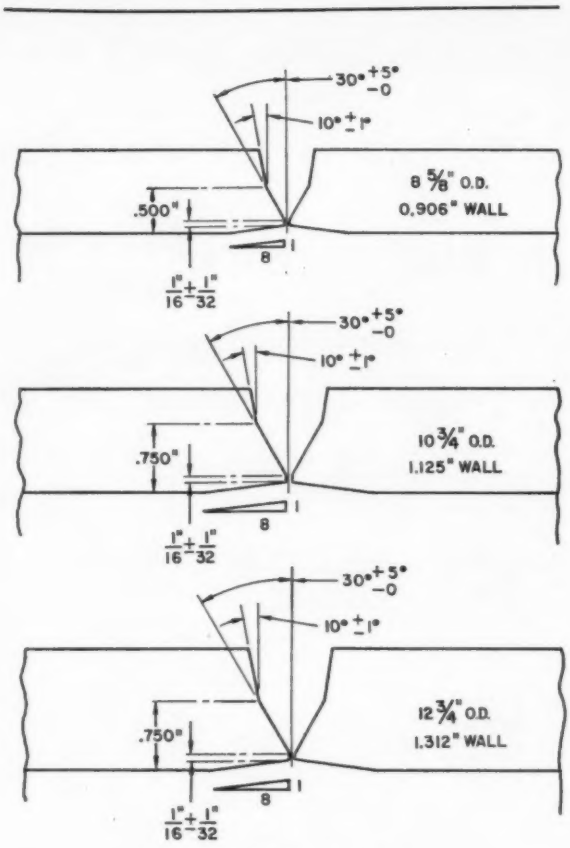


Fig. 1. End finish for line pipe.

Pipe welding also sounds like a simple subject. But here it becomes an important factor. The following will give an idea of some of the problems.

Because of the tremendous force exerted by the weight of the pipe, there was some difficulty in handling and assembling the pipe, particularly on steep slopes. Fluctuations in ambient temperatures, especially on hot days and extremely cool nights, and attendant contraction and expansion of the pipe made it difficult to fit the pipeline to the contour of the ditch. This was of greater significance on steep slopes. Here pipe had to be restrained by cables.

We expected some problems would arise with jointing at slopes—alignment, pull-out effects, etc. But these were performed without incident. Downhill welding technique was employed.

By virtue of its weight—160.3 lb per foot—and mechanical properties, the pipe yielded quite readily

and conformed very well to the high and low points in the ditch bed.

In this respect we might add that cold bending of the pipe was performed with great ease.

On the other hand, supporting the pipe was quite troublesome. The skid breakage involved is hard to conceive. Normal replacements were exceeded by three to four times.

Each 12-in. field weld required 22 passes in addition to the root bead, and 5½ hours to complete. A strong tendency existed for slag to be trapped in the portion of the compound bevel just above the stringer bead. This problem beset the welders at the beginning. But the situation was corrected through practice and experience. Although there was some bad weather during construction, the effect on the welding operation was slight.

For comparative purposes the weight of the 12¾-in. OD, 1.312 wall pipe was 160.3 lb per foot. This is equivalent to a pipe 30 in. in OD with a .500-in. wall. The fillet volume per weld was 28.6 cu in. for the 12-in. pipe compared to 14.1 cu in. for a 30-in. pipe.

Because of the tremendous effort involved in performing a weld on this heavy wall pipe, it was obvious that double jointing at a central point had high merit. Double jointing on a production basis meant quick and accurate line-up and better weld consistency. Double jointing was performed with a semi-automatic welding machine using the submerged arc method. Each weld required a root bead and three hot passes by hand and about 30 passes with the machine. Total welding time for each weld was one hour, which is considerably lower than the 5½ hours required for the field welds. Each weld was X-rayed and then stress relieved. This phase of the work was performed by the contractor for the storage field piping.

An interesting angle concerning this project is the story behind the construction bidding. The contract was awarded to the lowest bidder. The winning contractor, aware of the calculated risks involved, had previously duplicated actual fabricating conditions using heavy wall pipe. This information provided a sound basis for bidding and also indicated that substantial savings in construction costs were possible by double jointing at a central location. Through these innovations he gained an undisputed advantage over the other bidder.

All pipeline valves were Series 2500 weld-end gate valves. They were ordered with an outlet extension on each end, two pipe diameters in length. This accommodated the stress relieving furnaces and also precluded (1) any damage to the valve from the furnace heat or (2) any possibility of a bad field weld at the valve.

The wellhead and field line drips were prefabricated and 100 per cent radiographically inspected. These are stepladder-type drips and were designed according to ASA B31.1.9-1955 Class A, Type B construction for an operating pressure of 5000 psig. The material conformed to ASTM A-106 Grade B specifications.

Each wellhead assembly consisted of two 5-in. lead lines with a 5-in. orifice fitting incorporated into one of the lead lines. These also were prefabricated according to the above ASA schedule. The material conformed to ASTM-A-53, Grade B Specifications.

In view of the critical pressures involved, the merits of a partial X-ray program were considered doubtful. We decided to X-ray 100 per cent. This was also true for pre-heating.

Every weld was visually examined by New York State Natural welding inspectors and X-rayed as completed by an X-ray contractor.

The psychological effect exerted by this program

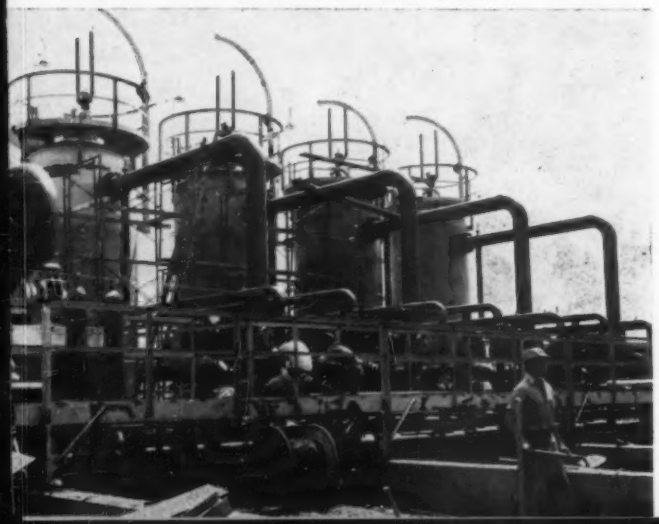
Twelve gas-fired annealing furnaces were used on joints to relieve stresses set up by welding. Temperatures from each joint were relayed to bus (left) where operator, using a potentiometer, regulated heat by calling to men through loudspeakers to make individual

temperature adjustments at each furnace. Welds were heated to 1200 deg, then gradually cooled at not more than 400 deg F per hr. Cooling from 400 deg down was controlled by covering welds with heavy asbestos blankets (right).

Each piece of 14-in. pipe for discharge line gets individual treatment. The 2-in. thick pipe was sandblasted before being coated with tar and felt and covered with kraft paper.

Gas piping on header side of compressor building. Line at right carries 5000-psi pressure; center line, 1500 psi; left line, 2500 psi.

Dehydration plant has four towers capable of drying out 250 MMcfd. When the project is completely developed, there will be four of these 4-tower plants.



was well worth the additional costs involved, as demonstrated by the results attained. Of about 2000 welds on the 12-in. piping only 36 were rejects—less than 2 per cent. Added construction costs as reflected by weld rejection were an important consideration, since the cost of replacing a defective weld was several times that of an ordinary weld. This system was hydrostatically tested to 6000 psig.

Stress relief was required on all welds whose thickness exceeded 1¼ in. The temperature was first raised to 600 deg F in not less than 20 minutes, then increased evenly at 300 deg F per hour to 1200 deg F. It was held there for 1½ hours and then cooled at a rate not exceeding 400 deg F an hour. Cooling from 400 deg was done by wrapping a heavy asbestos blanket around the weld.

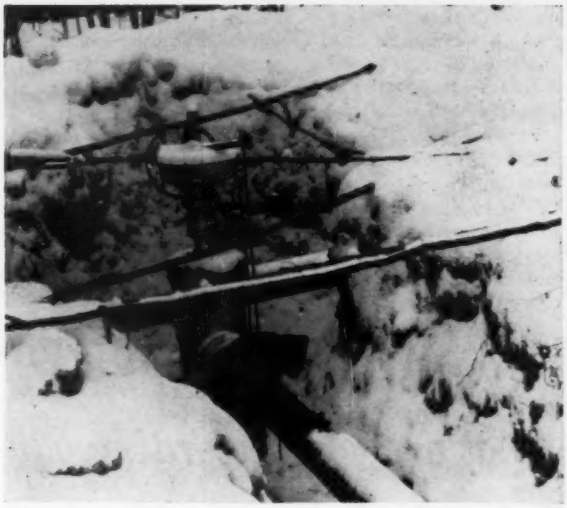
The stress relief cycle was achieved by furnaces specially constructed from heavy gauge plate by the contractor. These cylindrical chambers with an axial opening for the pipe were designed in two halves permitting quick assembly and attachment to the pipe. The bottom portion was placed under the weld and the upper part lowered to meet it, thus forming a tight fit all around the pipe. To facilitate the movement of each unit to the next site, plastic hoses were used to serve the natural gas needs of each furnace.

For various economic, operational and functional reasons, the gas-fired furnace was selected over an electric resistance unit. The number of furnaces constructed was primarily based on economics and the construction schedule. Because of the unlikely possibility of re-employing these furnaces their total cost had to be written off to this project. This expense, therefore, was important in determining the number of furnaces to be constructed. Total cost per unit was about $2000.

The stress relieving cycle was conducted on a 24-hour basis entailing two 12-hour shifts. This required an operator stationed on a mobile unit, three assistants attending the furnaces, and men and equipment to redeploy these units. The heating cycle itself required about six hours; the remaining six hours were devoted to redeployment, which was performed as one integral unit rather than on an individual basis. The mobile unit, a converted bus, was located midway between the end furnaces which were 700 feet distant. Working schedules were so arranged and the work progressed in such a manner that the distance between the stress relief and welding operations was held fairly constant—about 1500 to 2000 ft.

A unique feature of the stress relieving operation was the way the 12 furnaces were coordinated during the cycle. The cycle for each weld was recorded by a recording electric potentiometer mounted in a converted bus and connected to a thermocouple tack welded to the weld. Temperature adjustments at each furnace were made by personnel as directed by an operator located in the bus and using a loud-speaker. Inclement weather affected the stress relieving cycle to some degree, but it was less vulnerable to high winds than to rain or snow.

The heart of the storage operation is the compressor station situated about in the center of the pool. When completed, this station will have 15 engines with a total of 27,000 hp.



Because of critical pressures involved, the line was 100% X-rayed. Every weld was visually examined by New York Natural welding inspectors (right), then X-rayed by an X-ray contractor (left).

Leidy storage is being developed and will be operated by New York State Natural Gas Corp., which has a half interest. Transcontinental Gas Pipe Line Corp. and Texas Eastern Transmission Corp. each have a one-fourth interest in the joint venture.

The initial phase now in operation is providing about 12 billion cu ft for Transco's customers during the 1959-60 season. The ultimate 60 billion cu ft of top gas will be provided after Texas Eastern and New York Natural elect to store gas in the pool. Cushion gas will amount to about 45 billion cu ft.

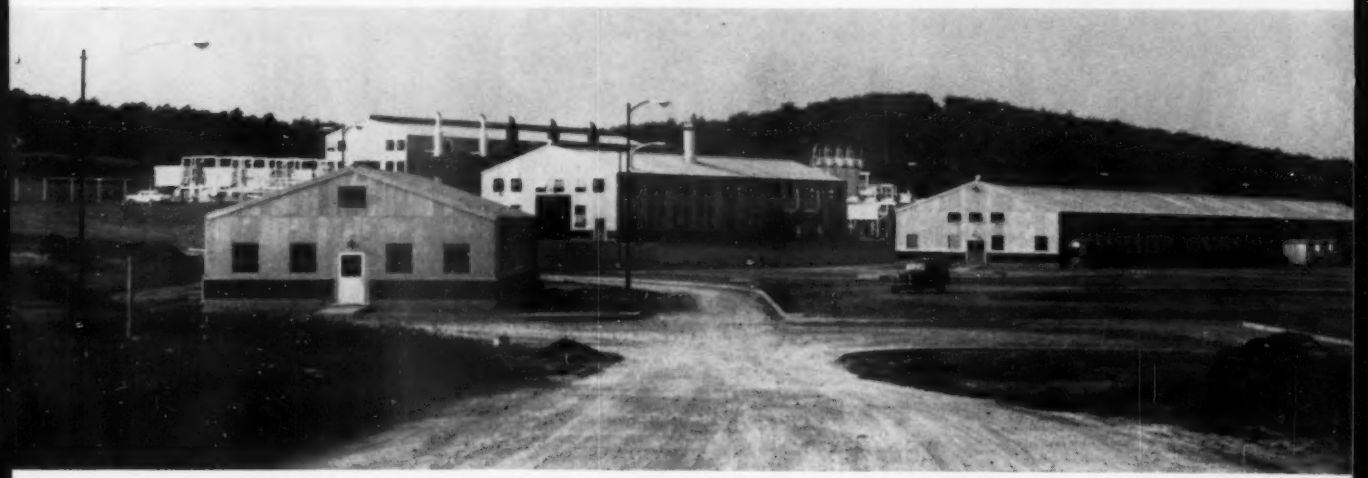
When fully developed, the pool will be operated at a maximum pressure of 4200 psig with surface injection pressures approaching 5000 psig. Gas will be delivered to the three participating companies at 1200 psig. This large differential will make large quantities of peaking gas available. It is estimated that the pool will deliver 800 MMcfd when 93 per cent of the top gas has been removed.

The knowledge and know-how of some of the industry's most versed men are incorporated in the design features of this project.

Successful completion of the first phase is in a great measure due to the joint efforts of New York Natural's engineering staff and supporting personnel in the field, the construction crews and the various fabricators whose advice and suggestions contributed immeasurably.

Projects of this nature unquestionably contribute to the progress of our civilization. ■

Leidy station stands atop Tamarack mountain on the Finnefrock farm. Administration building is in foreground. Compressor building is behind it. In the middle is the auxiliary building and to the right is the warehouse-garage.



There's a Bristol recording gauge to give optimum results on *any* pressure range—whether it's full vacuum, 10,000 pounds per square inch, or a few millimeters of mercury absolute.

And whatever type of element you select, you know that Bristol's continuing research and development program has kept it far in advance of the field . . . incorporating into it the latest improvements in instrument engineering and element metallurgy.

The product of over 70 years of instrument experience, Bristol gauges are *completely field proved*—some have been in service for over 40 years! An outstanding record! Among men who know recording gauges, it's Bristol for reliability, every time.

And check these big advantages:

Easy-change elements. Elements are designed for easy interchangeability. You can buy a gauge with any standard helical element; change later to a standard capsular element, or *vice versa*. Flexible polyethylene tubing for capsular element connections further simplifies change, speeds maintenance, and provides vibration isolation.

Extra mounting rigidity. Greater accuracy, greater reliability are assured by a rigid, cast-aluminum element mounting.

Element materials for every type of pressure measurement: Ni-Span C, 316 stainless steel, trumpet metal, phosphor bronze, and beryllium copper.

Get complete data on Bristol recording gauges, pressure elements, gauge charts and a variety of accessories in 32-page Bulletin G621 . . . yours for the asking. Write: The Bristol Company, 119 Bristol Road, Waterbury 20, Conn.

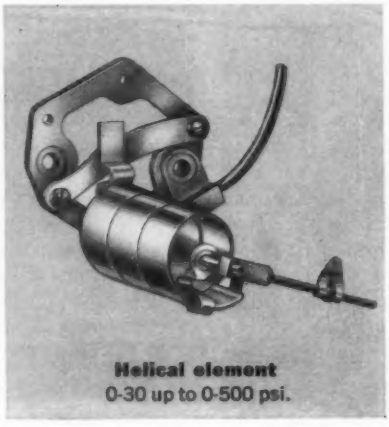
What are your recording gauge requirements?

Bristol elements blanket the pressure spectrum

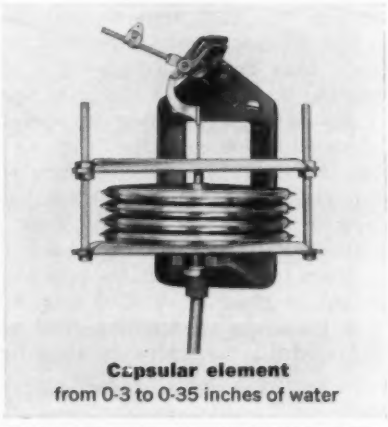
(0-6mm Hg Abs. to 0-10,000 psig)

. . . another big reason that more *Bristol* recording gauges are used than all others combined!

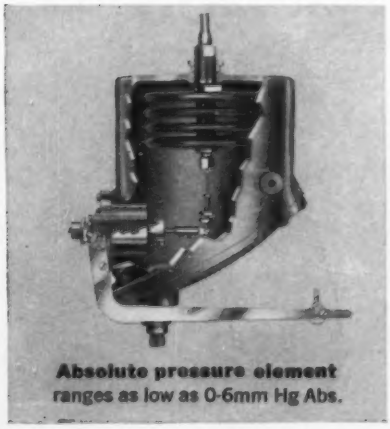
Helical element
0-500 up to 0-10,000 psi.



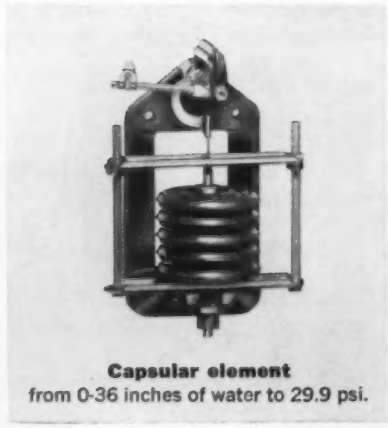
Helical element
0-30 up to 0-500 psi.



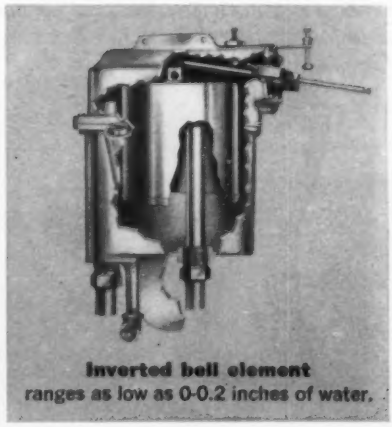
Capsular element
from 0-3 to 0-35 inches of water



Absolute pressure element
ranges as low as 0-6mm Hg Abs.



Capsular element
from 0-36 inches of water to 29.9 psi.



Inverted bell element
ranges as low as 0-0.2 inches of water.

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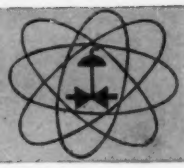
Communications and Automation



Edited by FRANK CHAPMAN

Communications related to pipeline operations

By F. VINTON LONG

MANY years ago you ran a pipeline by the seat of your pants in a manner similar to the original barnstorming fliers. Somehow most of them stayed alive, and somehow the original pipelines pumped their fluids.

This can still be done. You could, today, run a gas, crude, or products line without one sign of communication between facilities. If the pump or compressor stations were designed with this operation in mind, they, as part of the line, could run on a "hands off" basis, with no intelligence transmitted between each one. In other words, a gas compressor station could be designed to operate for transmittal of the maximum amount of gas with the least possible horsepower quite easily. A liquid line could do this with even less difficulty. However, all of this would be based on the fact that this would be a static operation with no changes in supply and delivery amounts and with the assumption that everything would work perfectly throughout the entire system.

This pipeline Utopia is pretty hard to find. Therefore, we must provide communications for at least off-normal operation from line design to provide a means of coordination between people who are endeavoring to bring the line back to normal or to repair malfunctions. Right there is where your basic pipeline communications become invaluable.

The day of using voice communications to maintain optimum pipeline operating conditions has come and gone. This whole thing can be carried out with comparatively few communication facilities which can operate on an automatic basis. Data will be provided on telemetered information from the pipeline facilities back to a simple mechanical thinker. This, in turn, will issue instructions as to what the motors and compressors and valves should do.

The line can operate without these gadgets, but it will usually be found that they are most helpful to enable the line to operate at maximum efficiency over the longest period of time.

Some of the things that pipeliners do not like to think about, but which occasionally happen, are malfunctions of the compressor and pump stations and the fluid conduits which connect them. When such malfunctions occur, you will require communication of some sort. You will require it at the moment, and you will require something that will stay in operation.

These communication facilities can be either privately owned or leased, and there are certain advantages to either type operation.

Privately owned facilities will provide a pipeline company with great flexibility, which is sometimes a necessity. But, on the other hand, this could be quite expensive during the period in which the pipeline is operating as it is designed. Leased communication facilities will remove from pipeline management the headaches of constructing and maintaining a fairly complicated communication facility. But, on the other hand, it is somewhat restricted as to complete flexibility. And, perhaps more important, it will place responsibility for vital communications and inherent pipeline operation in the hands of companies which are not primarily interested in the pipeline business.

Often the value of adequate communication facilities will not be used except in abnormal pipeline operations. If a catastrophe occurs, the availability can be vital. This can be compared to our own defense effort.

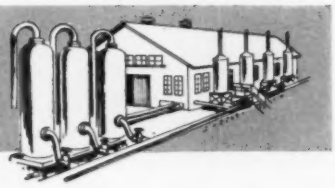
Communications directly related to normal operation of the pipeline can be limited in magnitude, so that often times there is little justification for expenditures of money required to construct private facilities such as microwave systems. However, there are other things to pipeline operations in addition to ascertaining how many barrels of crude or how many feet of gas are being pumped through at each moment. This includes executive conferences, accounting information, purchase and billing information; and information exchange between the pipeline company, its suppliers and its customers.

The route of the line many times will indicate the need for private facilities, such as a microwave system, if common carrier facilities are not available or would be too expensive to install. An example of this would be the microwave system used by Wilcox Trend Gathering System in southwest Texas where the microwave system is used little for executive traffic, but constantly as a relay system for communications between the gas dispatch office and vehicles adjusting and gauging hundreds of gathering points in that area. In this case, use of private facilities

Continued on page 132

This column is based on a paper presented at the communications session of the AIEE South West District 7 Meeting in Houston, April 4, 1960.

GAS PIPELINE NEWS



Transwestern Pipeline completed May 6

On Friday, May 6, the last weld was put on the 1800-mile Transwestern Pipeline. As described in May GAS, the Permian-and-Hugoton - Basin - to - California - border pipeline was begun Oct. 25.

"This means," says Mills Cox, president of Transwestern Pipeline Co., "that this gigantic pipelaying project was completed in 152 calendar days and an average of 128 working days for the 11 spreads. . . . This would have been a remarkable accomplishment under normal circumstances and ideal weather conditions, but this line's construction was plagued with some of the worst weather the desert country has experienced in years, including devastating windstorms, heavy snowstorms, floods, and other harassments."

Construction crews of H. C. Price Co. work across the flat, rocky terrain of Arizona, as they near completion of Transwestern Pipeline Co.'s 30-in. line.

Cox added that the line was not only completely welded and covered, but was about 50 per cent cleaned and tested. The carbon dioxide plant in the Puckett field has also been completed and tested and 65 per cent of the work on the compressor and booster stations is finished.

Meanwhile, Pacific Lighting Gas Supply Co. announced that work was over 50 per cent complete on the 34-in. line that will tie in Transwestern with the Southern California and Southern Counties Gas companies' system.

The complete system is expected to be in operation in July.

Uncover huge new reserves

Discovery of what is believed to be the second largest gas reserve in the world was announced by Green River Basin Corp., Chicago. Totaling 45 trillion cu ft, the new reserves are in the Green River Basin area in western Wyoming.

According to the company, the new find increases total present reserves—254.1 trillion cu ft—17.7 per cent. Based on present usage, this represents a 4-year gas supply for the entire nation.

El Paso can buy Wyoming gas

Three independent producers operating in Wyoming were authorized to sell natural gas to El Paso Natural Gas Co. Initial price was set at 15 cents per Mcf.

Sales, from the East La Barge field in Wyoming's Green River basin, will be by Belco Petroleum Corp., Humble Oil & Refining Co., and Pan American Petroleum Corp. The three companies had sought a 1-cent increase over the going 15-cent price, stating that they were obligated to deliver gas at a pressure of only 500 psi. The 1-cent increase would be for deliveries at 860 psi, enabling El Paso to inject the gas into its lateral without boosting pressure.

The examiner held that the question was not whether El Paso was willing to pay a higher price to get gas under more favorable conditions, but that the extra penny amounted to a 16-cent rate. This "certainly would not be holding the line" and "would affect rates to be charged for all future gas."

TGT reveals new reserves

Recent negotiations have added 3.2 MMcf to its natural gas supply, Tennessee Gas Transmission Co. revealed in a recent FPC filing.

The additions bring total reserves dedicated to TGT up to 18 trillion cu ft. The report on reserves, complying with a recent FPC directive, stated that 81 new gas purchase contracts had been made, along with amendments to existing contracts. "Extensive negotiations in a relatively short time" were required to acquire the new reserves in "a highly competitive market." The report added that current market prices were not exceeded and favored nation clauses were not triggered.

TGT is continuing to purchase new gas supplies "as rapidly as possible," and is pushing development and control of its own reserves.

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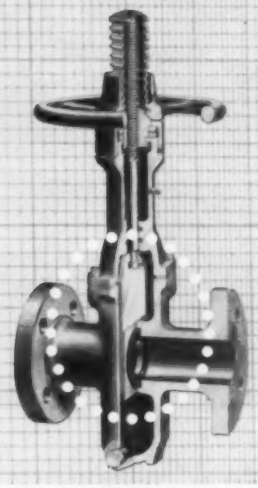
Creative Engineering



FLOATING SEATS MAKE THE SEAL

Seats are specially formulated rubber molded to a hardened steel insert. They float against the gate. When the gate closes, line pressure forces the gate against the downstream seat making a tight seal. The upstream seat maintains its seal against the gate for an upstream seal. The valve provides a tight seal under little or even no line pressure or under vacuum conditions.

W-K-M's new Pressure Sealing Gate Valve

Almost without effort . . . you get a tight seal on *both* sides of the line. The secret? A unique seat design that puts line pressure to work *for* you. The greater the pressure, the tighter the seal!

Seats automatically adjust for wear . . . automatically relieve excessive body pressure. And on-the-line overhaul is easy.

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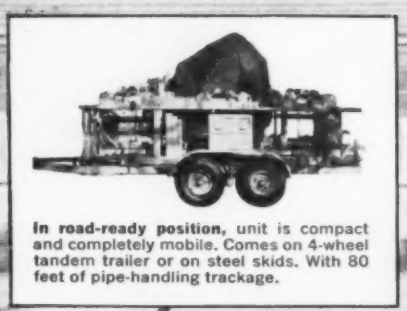
NOW! A portable high-speed taping machine for Polyken cleans, tapes and



In road-ready position, unit is compact and completely mobile. Comes on 4-wheel tandem trailer or on steel skids. With 80 feet of pipe-handling trackage.

New Polyken tape method handles ¾" to 4" pipe, cleans and coats 2,500 feet per hour and sets up anywhere

Probably the best thing about the Betzel taping machine and Polyken tape is the absence of all the nasty problems of hot dope. The highly mobile "Betzie," developed jointly by Polyken and A. E. Betzel, sets up in an hour (comes down in half the time).

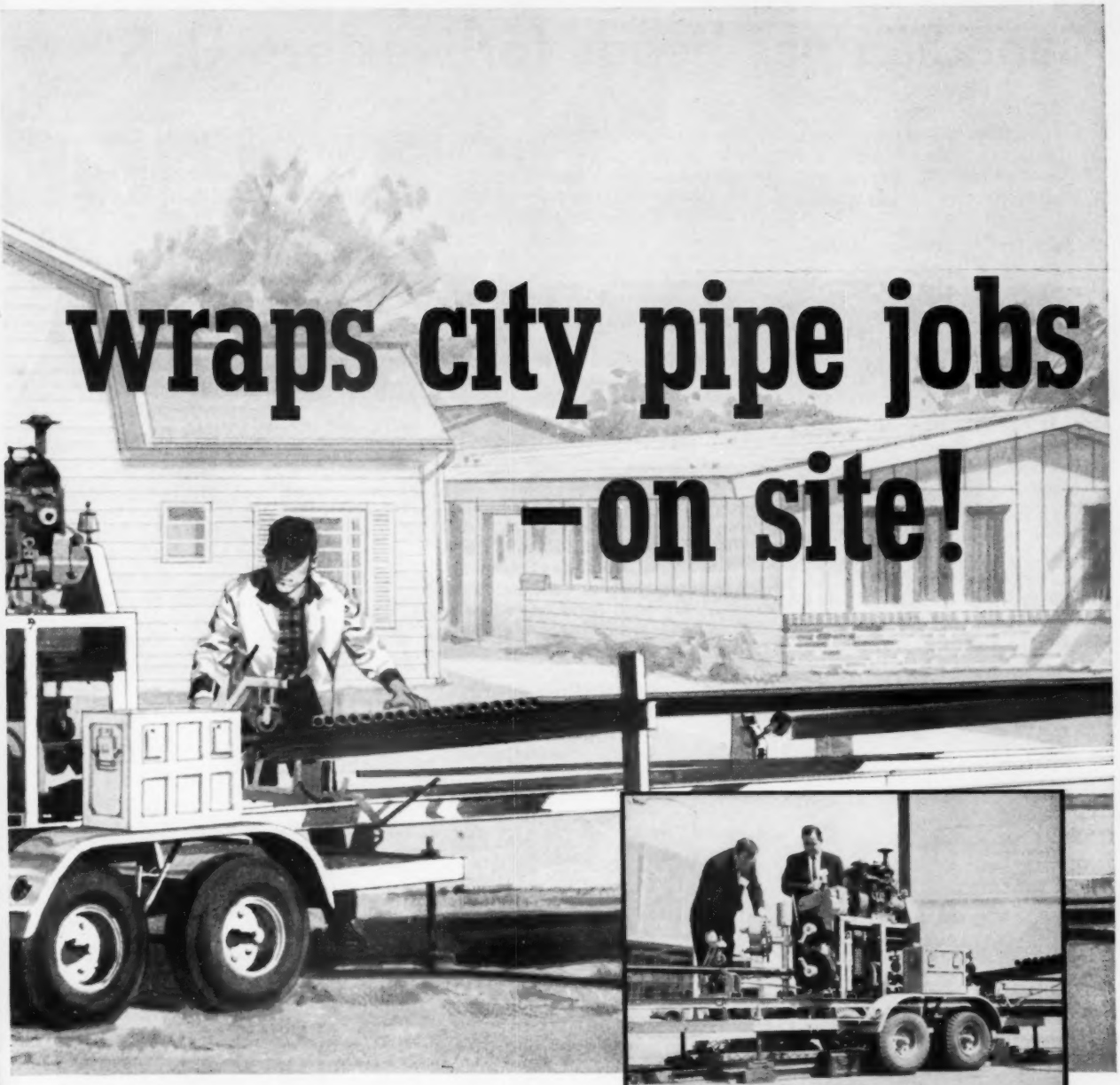
With only 6 men, or less, you run a continuous cleaning, coating and wrapping operation that processes 2,500 lineal feet per hour. Takes only 10 minutes to switch pipe sizes. And the savings? Well, just compare the time, labor, and small investment against the average hot dope operation.

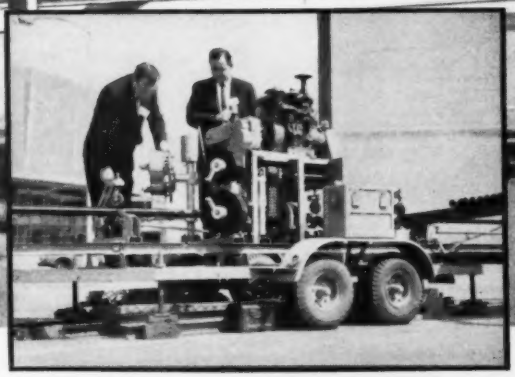
The practical Polyken way

With Polyken tape you know the coating is always ready. Goes on factory-smooth, too. No primer, no drying or cooling time. No fumes or fire hazards.

What's more, permanent Polyken tape can take almost anything—as already proved by its many hundreds of miles and years of hard work. It's being used in such tough terrain as the

wraps city pipe jobs —on site!





As the pipe spins through the "Betzie," twin powered brush heads afford dynamic cleaning—as shown in this demonstration at the 1960 N.A.C.E. meeting in Dallas, Texas. Other standard equipment includes twin brake-type tape and outer wrap spindles for rapid change of rolls, and an adhesive attachment for fast-gluing outerwrap.

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Canadian gas heads for western U. S.

THE vast, interconnected project that will move some 584.5 MMcfd of Alberta gas into California and the Pacific Northwest has a conditional okay.

FPC examiner Weston authorized three U. S. companies to import about 213.3 billion cu ft annually. Main destination is California, but Oregon, Washington, Idaho, and Montana will share in it.

Stringent conditions were imposed to protect consumer prices during the evolution of further Canadian regulation of producer and pipeline profits.

Five Canadian companies, two of which are wholly owned subsidiaries of U. S. companies, will sell or transport the gas. The entire international project, including facilities to be built in California, is estimated to cost about $400 million.

The only important issue, according to Examiner Weston, is whether the project, involving future costs to U. S. consumers based on unregulated Canadian field prices, "is consonant with the American public interest."

First pipe for the Winnipeg-Emerson extension of Trans-Canada Pipe Line's system from Alberta to Montreal was unloaded within days of gas export approval. Fifty-one miles of 30-in. pipe will be laid from Trans-Canada's mainline near Winnipeg south to Emerson. Six new compressor stations, using natural gas-powered turbines to drive the compressors for the first time on a Canadian pipeline, also will be built in Saskatchewan and Manitoba.

He reserved the possibility of future American-Canadian arrangements for consumer protection similar to those now in effect in the U. S. He provided for full publication of facts of profits and prices in annual reports to be made to FPC.

If all concerned are continuously supplied with the facts behind the prices at the Canadian border, there would be basis "for consumer protection by way of treaty, joint commission, other Canadian-American understanding, or further Canadian regulation."

U. S. companies importing Canadian gas are Pacific Gas Transmission Co., San Francisco; El Paso (Texas) Natural Gas Co., and Montana Power Co., Butte. Both El Paso and Montana Power already are importing Canadian gas.

PGT will buy gas from Alberta & Southern Gas Co. Ltd. at the U. S. Canadian boundary, near Kingsgate, B. C. It will then move it to the California-Oregon border for delivery to Pacific Gas & Electric Co. In turn, PG&E will distribute and sell the gas in California. Alberta & Southern is a wholly owned subsidiary of PG&E, which also owns 50 per cent of the stock in Pacific Gas Transmission.

Alberta & Southern will buy gas from producers in Alberta fields. Alberta Gas Trunkline Co. Ltd. will move the gas to the Alberta-British Columbia border. From there, Alberta Natural Gas Co. will move to the U. S. Canadian border for delivery to Pacific Gas Transmission.

• Construction

PGT will build a 36-in., 614-mile line from the Kingsgate interconnection through Idaho, Washington, and Oregon, to Klamath Falls, Ore. Estimated cost: $133 million.

PG&E will receive through its interconnection 418 MMcfd, or 152.5 billion cu ft yearly.

Gas for El Paso's northwest division will be purchased in the Alberta fields by Westcoast Transmission Co. Ltd. Then it will be transported through facilities of Alberta Gas Trunkline and Alberta Natural to Kingsgate for delivery to Pacific Gas Transmission. PGT will move the gas 105 miles to a connection with El Paso's system. In turn, El Paso will build 17 miles of new line to carry the gas to the Spokane area. Cost of El Paso's facilities: $2.4 million.

A daily average of 136.5 MMcf of Alberta gas will pour into El Paso's northwest division—49.8 billion cu ft annually. This volume replaces gas now flowing northwest from Ignacio, Colo., out of the company's southern system. Now, the replaced gas will flow westward to California markets.

Montana's import plan also involves Alberta gas purchases by Alberta & Southern and transportation by Alberta Trunkline. Also involved is Canadian-Montana Pipe Line Co. The Montana Power subsidiary will move the gas to the Canadian-Montana border. Average day deliveries will be 30 MMcf.

In addition to the interstate facilities of Pacific Gas Transmission and El Paso, intrastate projects are planned by PG&E at a cost of $82.4 million and by Montana Power, costing $2.6 million.

• Prices

Examiner Weston, agreeing that the project is one that "has captured the imagination of all concerned," pointed out that it was unopposed "in principle." But he ruled that FPC must search out latent dangers to consumers' interests, and provide adequate safeguards to protect consumers.

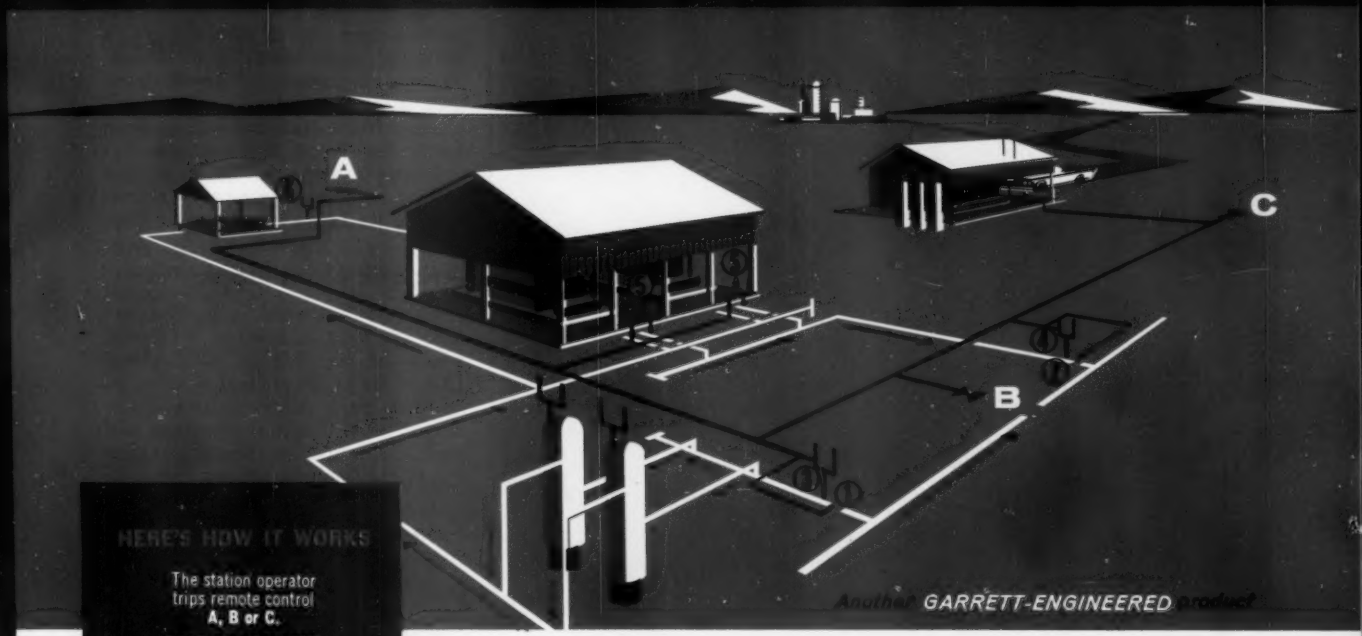
Initial price of Alberta & Southern's purchase contracts amount to 16.61 cents per Mcf, on the basis of U. S. currency and pressure base measurement. Period escalation clauses, redetermination provisions, and favored nation clauses are included. Westcoast will incur costs estimated to amount to 20.73 cents for gas purchases from the Savanna Creek and Calgary fields combined.

The examiner said the price of the project gas would be more than the estimated future price of domestic gas to the same markets. But, Canadian gas would not be grossly out of line during initial years.

Trunkline is proposing an overall return of 7½ per cent or higher; Alberta & Southern, Westcoast, Alberta Natural, and Canadian-Montana propose a flat 7½ per cent; Pacific Gas Transmission, 6½ per cent flat. These figures are expected to decrease under the examiner's ruling.

New Safety! *for compressor stations*

GARRETT SAFETY SHUT-IN SYSTEM



HERE'S HOW IT WORKS

The station operator trips remote control **A, B or C.**

STATION ISOLATED

Suction firegate closes

Discharge fire gate closes

PRESSURE DISCHARGED

Suction relief valve opens

Discharge Relief Valve opens

Compressor unit relief valves open

ENGINE SHUT-DOWN

Fuel gas relief valve opens

Tripping a single remote control instantly isolates a compressor station from the main line while simultaneously cutting off engine fuel and blowing down internal lines in Garrett's new safety shut-in system.

The station can be restored to service quickly without purging of lines. Block valves permit continued operation of station during periodic blow down testing of valves without loss of thousands of dollars in gas.

Designed to work with relief valves normally installed at compressor stations and with existing engine starting air pressure . . the Garrett safety shut-in system may be obtained for little more than the cost of adding "type EO" operators to the existing relief valves.

Check with your nearby Garrett representative or write direct for the full story of this NEW safety shut-in system for your compressor stations.

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Four-way plan being heard

FPC is hearing construction plans of Texas Eastern Transmission Corp., Algonquin Gas Transmission Co., Transcontinental Gas Pipe Line Corp., and New York State Natural Gas Corp. Involved in Dockets G-18968, et al, is an estimated $61.3 million.

Texas Eastern's plan: about 212 miles of 20- to 36-in. line, a 3300-hp compressor station, and two measuring and regulating stations in Pennsylvania, New Jersey, New York, and Mississippi. Cost: $46.7 million. With the new facilities, Texas Eastern's delivery capacity, east of the Oakford and Leidy storage pools in Pennsylvania, would be increased.

Texas Eastern also would be able to deliver proposed sales volumes of up to 20 billion cu ft yearly, on an interruptible basis, to four companies of the Consolidated Natural Gas system. Also, up to 340.7 MMcfd and 20.4 billion cu ft annually, on a long-term firm basis, to 20 existing and two new customers during each winter period.

Algonquin Gas wants to add 12,000 hp to its Cromwell (Conn.) compressor station and build some 25 miles of 20-in. and 8 miles of 8-in. line in Massachusetts. Cost: $6.2 million. Long-term winter service will be provided—up to 75.2 MMcfd and 4.5 billion cu ft annually to 18 existing firm customers. Algonquin would buy the gas from Texas Eastern.

Texas Eastern, Transco, and New York Natural jointly proposed to develop Texas Eastern's share of the Leidy storage pool. They'll build 6.5 miles of 20-in. and 4.8 miles of 16-in., a dehydration plant with a capacity of 250 MMcfd, a 5000-hp compressor, and miscellaneous equipment. Total cost: $5.8 million.

New York Natural will operate Leidy for Texas Eastern.

Transco plans to build a $2.5 million, 6000-hp compressor station on its Leidy transmission line.

Atlantic plans loops

Atlantic Seaboard Corp., Charleston, W. Va., is seeking FPC approval of its plan to build about 13.4 miles of 26-in. and 6 miles of 20-in. loops in Virginia and Maryland. The $1.9 million program will enable Atlantic to increase capacity of its Cobb-Baltimore line.

Plans Mississippi crossing

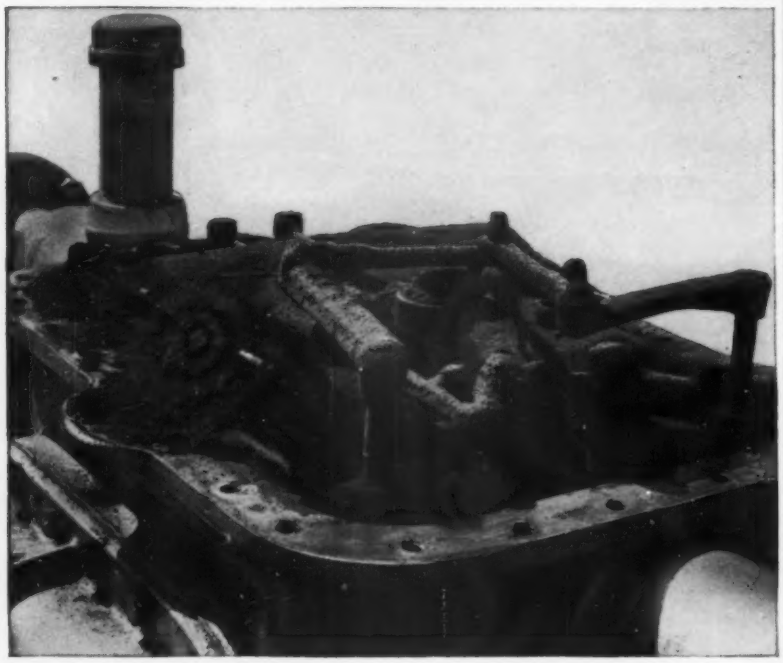
When FPC approves, Columbia Gulf Transmission Co., Houston, will cross the Mississippi river with a dual-24-in. underwater line. The building site, near Lake Providence, La., is about 1.5 miles north of its existing crossing. Cost: $3.5 million.

Equitable expands system

Equitable Gas Co., Pittsburgh, wants to build about 31.7 miles of 16-in. and 26.7 miles of 20-in. line in West Virginia and Pennsylvania. The facilities (Docket CP60-4), costing $5.3 million, will increase Equitable's overall system capacity some 76 MMcfd.

FPC names counsel

Luke R. Lamb has been named assistant general counsel of FPC. Lamb has been a supervisory trial attorney on FPC's legal staff since 1955. He succeeds W. Russell Gorman, who has entered private law practice.



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This meter was plugged by dirt that could have been trapped by a Blaw-Knox Gas Cleaner. Dirty gas clogs lines, sandblasts regulators, wears down compressors. With Blaw-Knox Gas Cleaners you get trouble-free fuel that cuts your costs while it builds highest customer relations. Send for Catalog 387. Buflovak Equipment Division, 1547 Fillmore Avenue, Buffalo 11, New York.

Buflovak Equipment Division

BLAW-KNOX

New ore supply sought by Lone Star Steel

Lone Star Steel Co. plans to buy millions of tons of iron ore located in the South Basin of Texas. Plans also call for possible construction of one or more smaller steel mills near the ore deposits. The amount of ore available will determine Lone Star's treatment of the plan.

If the company can buy enough ore, it will build one or more plants near the deposits. If the ore supply is short, Lone Star will ship it to its Morris county plant.

New process removes excess CO_2

El Paso (Texas) Natural Gas Co. ordered the first gas treating facility to use an advanced process developed by the Fluor Corp. This process purifies natural gas laden with gross amounts of CO_2.

The $3 million plant will produce 100 million standard cu ft of residue gas per day using the new design. Plant site is Terrell county, west Texas.

The installation will be the heart of an expansion program El Paso has undertaken in the Brown-Bassett gas field. Although natural gas from the field contains up to 53 per cent CO_2, it can be removed economically by the new process.

Fluor's Solvent CO_2 removal process uses an organic solvent to physically absorb high concentrations of CO_2 from natural gas.

Plans mainline construction

FPC hearings got under way last month on Michigan Wisconsin Pipe Line Co.'s $49.4 million expansion plan (Docket G-20569).

Covered in the plan: 341.8 miles of 24-in. mainline loop between Kansas and Illinois; 188 miles of 30-in. loops between Illinois and Michigan; and 36.8 miles of small diameter loops on existing market lines in Wisconsin. Michigan Wisconsin also would add 6000 hp in two Kansas compressor stations.

With the new facilities, Michigan can expand its average day sales to authorized customers by 100 MMcf. The gas would come from Oklahoma's Laverne field.

Michigan Wisconsin said it is becoming obligated to take more gas from the area than it presently has mainline facilities to handle.

RIGHT: Operating diagram of Darling gate principle. Fully revolving discs and complete release of wedging pressure during gate travel assure uniform wear distribution. Closure wedging automatically provides seating compensation for pressure-tight seating every time.

How Darling gate valves can help

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THE unique Darling gate valve principle, diagrammed above, provides today's best assurance of prolonged good behavior and avoidance of leaks and process interruptions! It's a natural where the most reliable operation is vital month in, month out.

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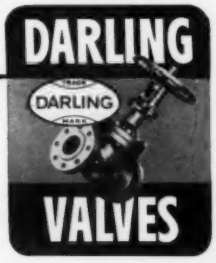

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These stock Daniel meter tubes feature the Flangnek-Simplex Orifice Plate Holder, the ideal replacement for orifice flanges. Where line by-pass or shut-down is practical, this dependable, ready-built unit offers efficient, maintenance-free operation. The plate carrier with plate lifts free of the Holder quickly and easily. Eliminates spreading of flanges and removal of gaskets. See your Daniel representative and get the full details.

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GAS Pipeline People

PAUL KAYSER has been elected to the newly created post of chairman of the board and chief executive officer of El Paso (Texas) Natural Gas Co. Elected president was HOWARD BOYD. Newly elected executive vice president is ARNOLD R. LAFORCE. Boyd was formerly executive vice president; LaForce was financial vice president. Kayser has served as president of El Paso since he founded it in 1928. Boyd joined the company in 1952 as vice president and assistant general counsel. LaForce has been financial vice president and director of El Paso since he joined the company in 1956.

J. FRENCH ROBINSON and JOHN M. HARBERT III are newly elected directors of the Houston Corp., St. Petersburg, Fla. Robinson has been prominent in the gas industry for many years. He was president and a director of Consolidated Natural Gas Co. from 1943 until 1951, and was chairman of the board until his retirement in 1955. At present, he is executive consultant to Republic Steel Corp., Cleveland, Ohio. Harbert in 1954 joined the original group planning to bring natural gas to Florida. He became a founding stockholder of the Houston Corp. He has been prominent in the development of natural gas systems in Georgia and the Carolinas, among which were Natural Gas Co. of Western Carolina (now a part of the Piedmont Gas System), and the Austell Natural Gas System in Georgia.

HAROLD C. JOHNSON is a vice president of Cooper-Bessemer of Canada Ltd., heading that company's manufacturing operations. He also becomes a vice president of the parent company. C. W. GILCHRIST was named plant manager of the new manufacturing facilities at Stratford, Ont., Canada.

Cooper-Bessemer also announced the appointment of DON B. BRAMLEY as a sales engineer, headquartering in Kansas City. JAMES C. DANGLER has joined the company as a sales engineer, working in the east-central sales district.

LEO C. GRAVIS has been promoted to manager of exploration by Trunkline Gas Co., Houston. He has been chief geologist since joining Trunkline in 1956.

Paul Kayser
El Paso

Howard Boyd
El Paso

A. R. LaForce
El Paso

J. F. Robinson
Houston

J. M. Harbert
Houston

Thomas Creden
A. O. Smith

Clem Straughan
Midwestern

Newly named general manager of A. O. Smith Corp.'s Tubular Division is THOMAS H. CREDEN. This division falls into the newly organized Capital Equipment Group of A. O. Smith. Creden also is a vice president of the A. O. Smith Corp. of Texas.

CLEM STRAUGHAN heads the newly opened St. Petersburg, Fla., office of Midwestern Pipe Line Products Co. He serves as southeastern manager for the Tulsa-based company.

HARRY T. HEUPLE has been propromoted to transmission superintendent with Pittsburgh Group companies of the Columbia Gas System. He succeeds R. E. GRANT, who retired recently following 43 years with the company. Heuple has been assistant transmission superintendent since 1955.

W. H. WOODS has been elected a vice president of Texas Gas Exploration Corp., Houston. He formerly was a vice president of Runnels Gas Products Corp.

EARL B. MARRS has joined Midwest Piping Co. Inc., St. Louis, as manager of the company's new Tulsa office. The territory includes Oklahoma, Arkansas, and northwest and west Texas. Marrs formerly managed the Tulsa sales office of the Walworth Co.

W. H. Woods
Texas Gas

Harry Heuple
Columbia

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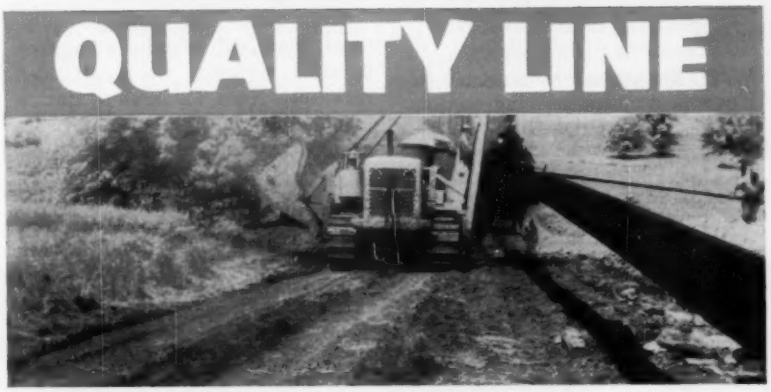

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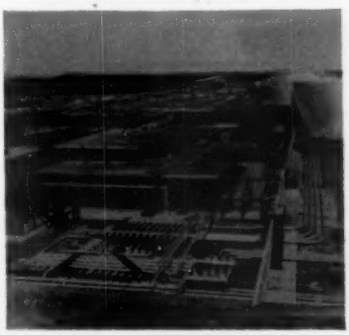

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JOHN F. MERRIAM, president, has been elected to the new post of chairman of the board and president of Northern Natural Gas Co., Omaha. MAX A. MILLER, a director of Northern for 17 years, was named to the new post of vice chairman of the board.

JACK E. STOFFREGEN has been named superintendent of the Peoples Gulf Coast Natural Gas Pipeline Co. compressor station near Biggers, Ark. He succeeds J. R. BUFFINGTON, who is taking an extended leave of absence because of illness. JAMES R. IVEY, special engineer in the Chicago headquarters, succeeds Stoffregen as superintendent of affiliate Natural Gas Pipeline Co. of America's booster station near Pampa, Texas.

FRANK G. SCOTT II has been named assistant superintendent of the Transcontinental Gas Pipe Line Corp.'s gas control department in Houston.

W. H. ROSSER has been named to the new post of engineering section chief for Continental Oil Co.'s interstate gas sales activities.

communications • *Cont'd.*

from page 121

can stand on its own solely for dispatching purposes. Its use for executive traffic, accounting, etc., is a minor consideration.

While we are on the subject of private microwave facilities, I would like to point out that several pipeline companies use them exclusively, others not at all, while the majority use both microwave and leased line facilities, as the individual case indicates. Economically, and from a maintenance standpoint, a privately owned microwave system can be either a smoothly running operation or a terrible headache. The headache usually becomes predominant if insufficient money is spent on the microwave system to provide the very highest quality equipment.

Even with high quality equipment, there still remains a bugaboo in such systems: the unattended repeater. Need for such a station involves a whole variety of problems: obtaining suitable sites, providing access roads to them, installation of a.c. power facilities, and the ticklish question of what type standby power to install. On top of this is added sometimes the necessity of providing aviation lighting, and working out some method for maintenance personnel to visit the station during times of bad weather. The best repeater is, of course, none at all, as it is a very expensive portion of a microwave system and usually is the determining factor as to whether or not a system should be installed at all.

I have long preached on my soap box for some manufacturer to bring out a microwave repeater which could be bolted on a fence post, have no tubes to wear out, no power supply to become cantankerous, and absolutely no maintenance requirement.

This complete repeater Utopia is not quite here. Recently, however, there have been several major technical breakthroughs which bring it much closer to around-the-corner. These include the parametric amplifier, the traveling wave tube, and the Esaki tunnel diode. Use of this type equipment would, of course, reduce station power requirements to a point where solar energy fuel cells or thermo-electric devices could adequately power the station.

At that time, when all this comes about, and only then will private microwave installations be economically feasible for the majority of industrial users with low density channel requirements.

Many of the communication needs of pipeline companies, and particularly those companies which have extensive gathering systems or numerous sales points, are not yet available. They could be made available by closer cooperation and coordination between the pipeline companies and common carriers involved. This joint effort to bring about better pipeline efficiency would often indicate the use of interconnection between privately owned and common carrier facilia means to provide standard teleties. An example of this would be phone facilities at numerous gathering points with equipment which,

Gives visual or electrical indication of pig passage. Pig-Sig II with electrical indicator signals pump station operator or starts operation of automatic equipment. For other applications and complete details write for bulletin A-199.

DEPT. C-2

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REPRESENTATIVES AROUND THE WORLD

on an on-call basis, could provide the dispatcher with telemetered information indicating operation of the well or sales point concerned. Conversely, this same line could be arranged to provide, also on an on-call basis, simple telecontrol facilities which might be used to open up or shut down the gathering point. This has been a relatively unexploited market for the common carriers. (If you will let me digress for a moment, this same application could apply to any utility having a metering system, such as water, electric, and gas distribution system.)

Because of recent developments, especially in the "solid state" field in electronic equipment, it is quite possible that many times it would be advantageous for a pipeline company to install short, privately owned, narrow-band radio links connecting inaccessible areas with either their own or leased backbone circuits which would transmit the intelligence to a central office. In the past, such installations were impractical because of power requirements and heavy maintenance. Within a year or two this detriment will have been overcome. There again interconnection would benefit both the common carrier and the owner of the pipeline system.

The common carriers have done an excellent job in providing both voice and tele-control communication facilities. They are also able to provide several specialized communication services, such as data transmission facsimile, etc. I believe it is technically feasible at this time for them to offer combined voice and telemetering channels for simultaneous operation at a nominal cost. This should provide quite a market for these carriers.

One thing that has always worried industrial users, and particularly long haul pipeline companies, is the vulnerability of common carrier facilities to bad weather, lightning, or other accidents, since usually all their eggs are placed in one communication-link basket. This problem could be solved to some degree with the provision by the common carriers of alternate routing facilities. This could be an extremely important point where telecontrol techniques are employed for operation of an automatic pipeline. It is, of course, understood that such alternate routing might involve the construction of duplicate facilities in outlying areas, and this may be quite expensive, but probably not prohibitively so, in many areas. Alternate routing, I believe, should be quite easy between major trunking centers of the common carriers. And I believe the common carrier should take a long, hard look at this situation and see if it would not be possible to provide right-of-way companies with priority privileges of such alternate routing operation as is now accorded some of our government services.

I would like to say that suppliers of privately owned equipment and the common carriers are doing everything they can to make life easier for those of us in the pipeline communication business. ■

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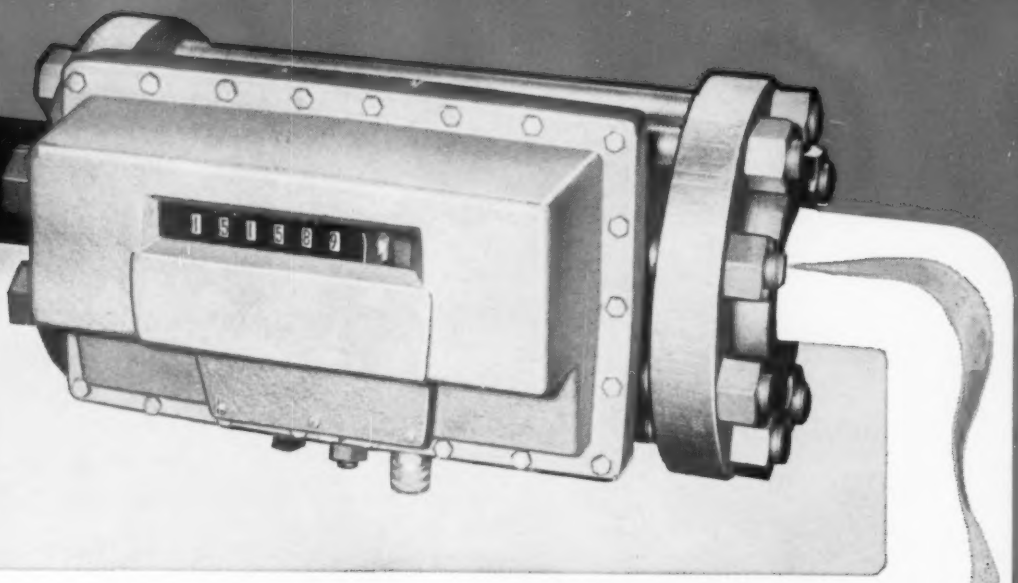

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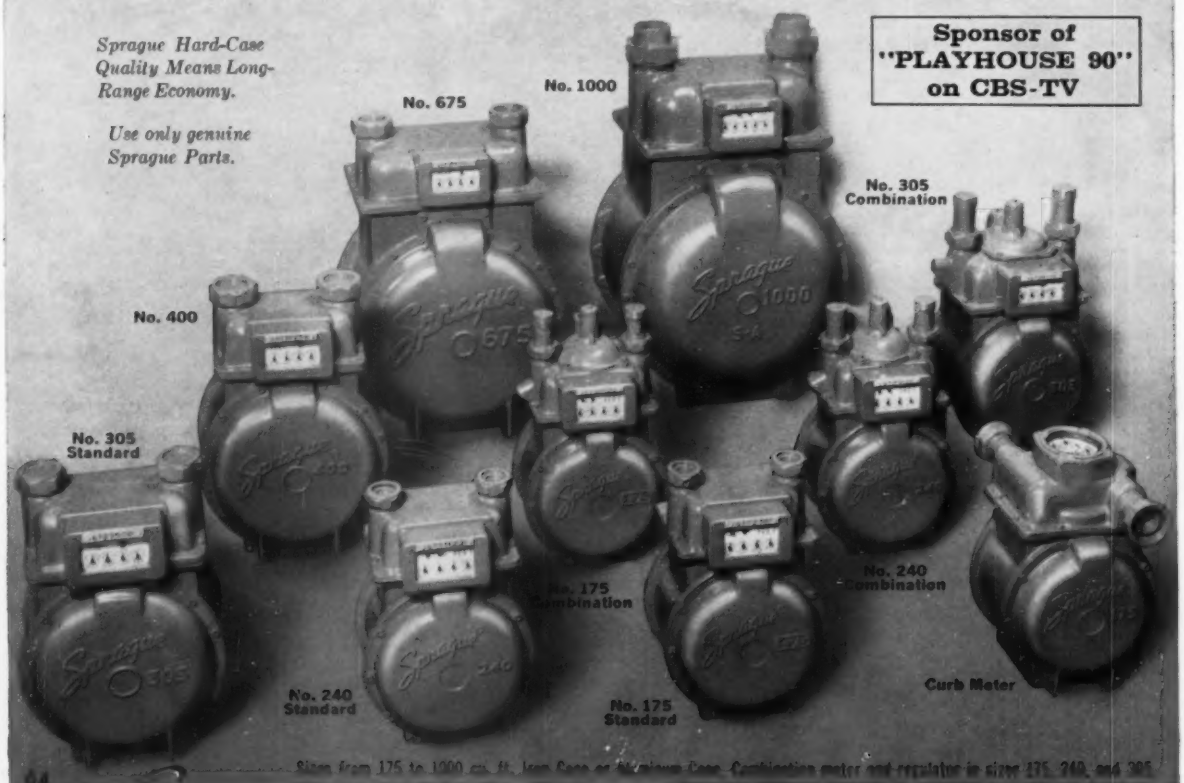

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